



## **City of Winooski**

### **Public Works Standards and Specifications**

27 West Allen Street

Winooski, VT 05404

[winooskivt.gov](http://winooskivt.gov)

802 655 6410 (City Hall)

802 655 1957 (DPW Garage)

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**APPENDIX A**  
**LIST OF FORMS AND APPLICATIONS**

SECTION 1

GENERAL REQUIREMENTS

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## SECTION 1 GENERAL REQUIREMENTS

### WORK TO CONFORM

- 1.1 All materials, design, and workmanship must meet nationally accepted standards and practices along with all applicable standards of the City of Winooski (hereinafter Winooski, the City, or City), including the City's Public Works Standards and Specifications. The City recognizes the State of Vermont Agency of Transportation Standard Specifications for Construction (latest edition) as a supplemental source for standards not detailed in the City of Winooski specifications. Where a conflict arises between the published standards established in this manual and other published standards, the more stringent shall apply.

During the progress of construction and upon completion, all work shall conform to these standards and the lines, levels, and grades as indicated on plans approved by the City of Winooski. Field revisions necessitated by the conditions of the site must be approved in writing by the Design/Project Engineer and accepted in writing by the Department of Public Works (hereinafter Department, the Department, or DPW) prior to acceptance of the completed work. All work shall be performed in a thoroughly substantial and workmanlike manner.

### 1.2 PROTECTION OF WORK PERSONS AND THE PUBLIC

Work persons and the public shall be protected by the Contractor from any and all hazards connected with the construction work. Open trenches, materials, or equipment within the working limits of the public Right-of-Way are to be guarded by the use of adequate barricades or flag persons. All barricades left in position overnight are to be properly lighted. Kerosene pots are not acceptable. When work narrows the usable pavement, a flag person shall be employed to aid the flow of traffic so that there will be no undue delays. **The Contractor shall be held responsible for the safety of all work persons and the general public and all damage to property resulting from the Contractor's failure to protect persons or property from the hazard of open trenches, materials, or equipment at any time of the day or night within the working area.** All work shall conform to applicable VOSHA and OSHA requirements. During construction within the public Right-of-Way, the City of Winooski will be provided a Certificate of Insurance naming the City as additional insured by the Contractor.

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## BLASTING REQUIREMENTS

The Contractor shall perform a pre-blast survey of the areas where blasting is required and shall record existing conditions in written form, sketches, photographs, video tape, or any other form. All nearby buildings, foundations, driveways, roadways, and other  
**1.3** existing structures shall be inspected for cracks, loose masonry, and any other condition which might be attributable to blasting at a later date. The pre-blast survey shall be prepared by a Professional Engineer licensed in Vermont and a copy shall be provided to the City Department of Public Works.

A blasting work plan shall be prepared, signed, and sealed by a Professional Engineer licensed in Vermont. The Blasting Design Engineer shall have at least twenty (20) years of experience in construction blasting, and must be able to demonstrate involvement in at least five (5) projects with blasting within 200 feet of residential structures. The blasting work plan shall be submitted to the City Department of Public Works and Fire Department at least twenty-one (21) days in advance of the proposed blasting. The blasting work plan shall include:

- Details of the drilling and blasting patterns and controls for both controlled and production blasting.
- Station units of proposed shot, the number of blasts, and time of each blast.
- Monitoring point locations (crack gages, seismographs, decibel meters, optical monitoring points, etc.), data collection frequency, threshold limits, and action plans for threshold exceedances.

The blasting work plan and all blasting work shall conform to all VTrans and fire code standards. Damages and costs of whatever nature resulting from the blasting work  
**1.4** shall be borne solely by the Contractor.

## PROTECTION AND REPAIR OF EXISTING UTILITIES

The Contractor shall notify Dig-Safe (1-888-344-7233) prior to any excavation in the public Right-of-Way or utility easement limits. In emergency situations, the Contractor shall notify the Department of Public Works during regular office hours (7:00 a.m. to 3:00 p.m.). The contractor shall also contact Dig-Safe in any emergency situation, with the understanding that an emergency Dig-Safe response is imminent. In addition, the Department of Public Works shall be contacted **seventy-two (72) hours** prior to any scheduled work within the limits of the public Right-of-Way.

Whenever pavement, curbing, sidewalks, trees or planter boxes, bollards, retaining walls, structures, monuments, culverts, sewers, drains, manholes, catch basin connections, water mains, electric conduits, telephone conduits, utility poles, overhead lines or other existing facilities are encountered, they shall be protected and firmly supported by the Contractor at his/her own expense, by methods approved by the Design/Project Engineer. Damage to any such structures caused by or resulting from the Contractor's operations, shall be repaired at the Contractor's expense within a time period that will not place an unreasonable burden on the users. The authority having charge of any particular underground structure shall be notified promptly of damage to its structure.

Pipes or other underground structures encountered in excavating or trenching shall be permanently supported by methods acceptable to the Department of Public Works for municipal utilities and the utility owner.

#### **INSTALLATION OF NEW UTILITIES**

- 1.5** All new site plans and subdivisions, including street intersection crossings, are required to have all utilities (e.g. electricity, communications) below ground.

#### **1.6 RECONSTRUCTION OF EXISTING UTILITIES**

In no case shall the Developer/Contractor move, change or repair any water main, sewer main, electric conduit, telephone conduit, utility pole, anchor, or any underground cables, conduits or structures without permission of the Director of Public Works and the utility owner, and until they are satisfied that adequate warning to the users has been provided. The Developer shall be responsible for the work and for providing notice to users before interrupting service. Reconstruction, both overhead

- 1.7** and underground, of the utilities shall be at the Developer/Contractor's expense, unless specifically provided for by written agreement.

#### **PERMITS AND CITY FEES**

The Contractor shall obtain all federal, state, local or utility company permits necessary prior to initiation of construction. The Contractor shall maintain these permits in force during the length of the contract and comply with the content of the permits at all times. All permits shall be readily available on site at all times.

All City of Winooski fees will be determined from the City of Winooski Fee Schedule, latest edition. This document will be made public and may be requested from the

Department of Public Works at any time. Any City of Winooski fees are subject to change at any time at the discretion of the City.

### **WORK OUTSIDE PROPERTY LIMITS OR WITHIN PUBLIC RIGHTS-OF-WAY**

- 1.8 The Contractor shall not (without written consent of the property owner in the form of an easement) enter or occupy with persons, tools, materials, or equipment any private land, other than their own. In a similar manner, no excavation shall take place within the public Right-of-Way without first obtaining written authorization from the City or State, as applicable.

All easements shall require title searches and certification by an attorney. Easements shall be accepted by the Department prior to issuance of any City permit.

### **PRE-CONSTRUCTION MEETING**

- 1.9 Pre-construction meetings are required for all proposed public improvements to be accepted by the City.

Before a pre-construction meeting can be held, the Developer must provide the Department of Public Works with the following information:

- Proposed or Executed Right of Way Permit;
- All deeds and/or easements;
- Cost estimate for construction;
- Evidence that all requirements and conditions imposed by the Development Review Board and/or Planning Commission have been met;
- One (1) copy of all approved plans and specifications;
- Evidence that the required Mylar depicting all lots, Rights-of-Way and easements has been filed;
- Associated Traffic Control Plan in accordance with MUTCD standards, latest edition.

Following receipt, review, and acceptance of the required documentation, the City will schedule a pre-construction meeting. In attendance will be:

- Developer;
- Design/Project Engineer;
- Contractor;
- Department of Public Works Officials;
- Planning Department Officials.

The meeting will consist of exchanging information between the Developer/Owner, Contractor, Design/Project Engineer, and the City. Specifically, the Developer should be prepared to discuss:

- Project phasing and timing;
- Utilities connection/extension;
- Construction schedules;
- Anticipated paving schedule and plans for winter treatment of roads;
- Erosion and dust control measures and maintenance;
- Traffic control; including pedestrians;
- Haul routes;
- Project supervision;
- Provide the City with an emergency contact list including the key people involved in the project, condensed onto one (1) sheet.

The City will discuss and review specific portions of the Public Works Standards and Specifications, including the Right of Way Permit, utility testing, service connection procedures, water meter installations, road preparation, and other related items.

#### **1.10 STANDARDS FOR PAVEMENT CUT**

All Contractors performing road cuts will provide proper road signs and traffic control if in City Right-of-Way.

Refer to the City's ordinance Chapter 22, Article IV, Sections 22.06 "permit required to dig or obstruct public way" and 22.08 "cuts and excavations to have protective barriers: repairs and restoration of streets". Saw cuts only; 45° angle to traffic flow wherever possible.

Backfill will be compacted in 6" lifts for pipe bedding within two feet of top of pipe with 12" lifts above that to 95% dry density (Standard Proctor). The top 12" minimum subbase will be of crusher run gravel or dense graded stone. If thickness of existing subbase layer adjacent to pavement cut exceeds 12", thickness of preplacement subbase shall match that of existing. Thickness of pavement patches shall match that of cut pavement.

Asphalt, curbing, topsoil, etc. will be completed within at least fifteen (15) days after cut has been made, or at the discretion of the Director of Public Works. During the winter months, temporary fill may be used at the approval of the Department of Public Works, with the expectation that the permanent repair will be completed at the earliest possible time.

### **SUPERVISORS ON THE JOB SITE**

- The Contractor shall ensure that there is a supervisor or responsible individual with the authority to make decisions for the Contractor under his/her direct employ on the job site at all times that construction is underway, whether or not the construction is being
- 1.11** accomplished by a subcontractor hired by a general contractor. The Contractor's supervisor or responsible individual shall meet the OSHA requirements of a "competent person" (29 CFR 1926.32(f)).

### **CONSTRUCTION/WARNING SIGNS**

- 1.12** Construction warning and approach signs shall appear at each end of any public highway under construction and on all intersecting public highways. The exact placement of any sign will depend upon the alignment of the highway and the character of the roadside. The location, measurements, minimum spacing, and design of the signs shall conform to the standards prescribed in the Manual on Uniform Traffic Control Devices (MUTCD), latest edition.

The signs shall be of metal, wood, plywood, hardboard, or any other material satisfactory to the Director of Public Works. No material shall be accepted that will deteriorate by exposure to the weather during the required life of the sign.

- The signs shall be in place at the time the project officially commences. Each sign shall be erected in a neat and workmanlike manner and shall be maintained by the
- 1.13** Contractor.

### **MAINTENANCE AND PROTECTION OF TRAFFIC**

The Contractor shall provide Uniformed Traffic Officers (UTOs) or certified flag persons if deemed necessary by the City. Only UTOs shall direct traffic at signalized intersections and the cost of UTO services shall be paid for by the Contractor.

The Contractor shall, as conditions warrant, employ certified flag persons at any location on the project where his/her equipment or construction operations are such that they will in any manner interfere with the movement or safety of the traveling public within the public Right-of-Way.

The Contractor shall notify the Director of Public Works, Police, and Fire Departments at least **seventy-two (72) hours** in advance of any need to close streets. Closing

streets shall only be done as a last resort. The Contractor shall work with the City to establish a suitable alternate route, and shall at his/her own expense, provide and maintain suitable marked and well-lit detour signs.

The Contractor shall provide a temporary traffic control plan signed and sealed by a Professional Engineer licensed in Vermont for review and approval by the City of Winooski prior to closing and streets.

The employment or presence of certified traffic flag persons or UTO does not relieve the Contractor of responsibility or liability.

### **SUBMITTALS, TESTING, AND INSPECTION REQUIREMENTS**

#### **1.14 1.14.1 General**

Proper construction requires field verification of materials and technique. The Contractor shall provide submittals for all proposed materials and techniques to the Department of Public Works for review before proceeding with ordering, fabricating, installing, or any other work.

All projects require either periodic or full-time inspection by the Design/Project Engineer, or a qualified third-party engineer, experienced in the area of construction to be undertaken, under the supervision of the Design/Project Engineer. Tests and results shall be completed and filed with the Department of Public Works on a timely basis. Upon completion of the construction, the Design/Project Engineer shall certify that required testing and inspection has been conducted and the project conforms to the accepted plans, project documents, and City standards and specifications. This certification is required prior to final acceptance of the project by the City, or the issuance of a Certificate of Completion.

The inspection schedule will be tailored for each project and set at the pre-construction meeting as applicable.

A final walk-through inspection of the project by the Design/Project Engineer and a representative from the Department of Public Works shall be required.

When the final walk-through inspection is complete, all deficiencies corrected, record drawings accepted, and the project certification received, the City will accept the construction and a warranty period of three (3) years will begin.

#### **1.14.2 Sanitary Sewer Systems**

A minimum **two (2) days** notice shall be given to the Department of Public Works so inspection of all materials can take place on the site before any work begins, and before testing of the pipelines and manholes.

The following sanitary sewer system general checklist will be used at final inspection:

- Manholes, pipelines, and appurtenances clean;
- Inverts and shelves with smooth transitions;
- Manhole frames and covers set at proper elevation;
- Disturbed areas stabilized;
- General appearance;
- Material testing results, lab reports, manufacturer's product sheets;
- Certificates, pressure and leakage tests, lamping and deflection tests, and pump test results are complete and on file;
- Tie-record information and record drawings are complete and on file.

#### **1.14.3 Water Distribution Systems**

A minimum **two (2) days** notice shall be given to the Department of Public Works so inspection of all materials can take place on the site before construction begins, before any activation of the system is made to the existing water system, and during testing, flushing, disinfecting, and sampling of new mains.

A Department of Public Works representative shall be present when any connection to the existing water system is made and during the testing, flushing, disinfecting, and sampling of new mains.

The following water main general checklist will be used at final inspection:

- Valves, hydrants, and curb stops are accessible and operating properly;
- Valve box covers and curb stops set at proper elevations;
- Disturbed areas stabilized;
- General appearance;
- Material testing results, lab reports, manufacturer's product sheets;

- Certificates, pressure and leakage tests, and disinfection/bacteriological test results are complete and on file;
- Tie-record information and record drawings are complete and on file.

#### **1.14.4 Storm Drainage Systems**

A minimum **two (2) days** notice shall be given to the Department of Public Works so inspection of all materials can take place on the site before construction begins.

The Department of Public Works shall inspect all storm drain, culvert joints, connections to catch basins, catch basins, and other storm drainage facilities, such as ponds and stormwater treatment facilities.

All storm drainage facilities will be inspected upon completion of the project using the following general checklist:

- Catch basins, manholes, and pipelines clean;
- Ditches and outlets clean;
- Erosion control measures completed;
- Disturbed areas stabilized;
- General appearance;
- Tie-record information and record drawings are complete and on file.

#### **1.14.5 Highways**

A minimum **one (1) day** notice for all inspections shall be given to the Department of Public Works so inspection of all materials may take place on the site before construction begins.

Samples of all subbase and base materials shall be tested for gradation and compaction requirements by a certified laboratory acceptable to the City in accordance with Section 5 of this document, at the Developer's expense. The responsibility for all testing shall be the Developer's. The material compaction shall be performed in accordance with VTrans Materials Sampling manual and Construction Standard Specifications, latest editions.

In addition to the compaction testing, a fully loaded, dual wheeled dump truck with a total weight not less than twenty-four (24) tons shall be driven over the compacted roadway subgrade and the depression left by the truck wheels shall be reviewed by the Design/Project Engineer and a Department of Public Works

representative to make a judgment on the acceptability or unacceptability of the roadway subgrade.

The Department of Public Works shall be notified in advance to inspect the construction of any and all roads at the following phases of construction:

- Preparation of subgrade;
- Placement and compaction of subbase and base material;
- Completion of finish grading;
- During the placement of the base course of asphalt;
- During and after the placement of the top course of asphalt.

The Department of Public Works shall inspect work during the placement of underground utilities, curbs, sidewalks, and driveway aprons.

A final inspection will be made after the completion of all roads, curbs, driveways, sidewalks, bicycle paths, and setting of all pins and monuments for lots and street Rights-of-Way. The following roadway general checklist will be used at final inspection:

- Settlement, depression, or imperfections in finish surface;
- Seeding and erosion control on cut and fill slopes;
- Surface drainage (during rainstorm);
- Disturbed areas stabilized;
- General appearance;
- Materials testing results and lab reports are complete and on file.

1.15

### **PROJECT ESCROW ACCOUNT**

All of the public works improvements to be dedicated to the City of Winooski are to be guaranteed through an escrow account provided to the City at no cost. The escrow account shall be in an amount sufficient to cover the total estimated costs of the improvements as accepted by the Director of Public Works. The escrow account shall be conditioned upon the satisfactory condition of the improvements for a period of three (3) years, from the date of final acceptance by the City.

Prior to establishment of a satisfactory dollar value for the escrow account, the Developer shall submit an accurate construction cost estimate on the form supplied by the Department of Public Works. The completed document shall be submitted to the Director of Public Works for review and acceptance prior to posting of a bond or escrow account.

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Releases to the escrow account will be made based on satisfactory progress, but no more than one release per month will be allowed because of processing requirements.

New development agreements are written with a fifteen (15) month construction period. Following City acceptance of final construction there is a three (3) year guarantee period with a ten (10) percent retainage held on the Right of Way Permit.

Projects are generally split into phases with a separate Right of Way Permit for each phase. To avoid conflicts over reductions in payment and questions over responsibility for winter maintenance during construction, the following procedure is established:

- It is recommended that the top course of asphalt not be laid during the first construction season as construction settlement or frost damage historically shows up the following spring. By postponing the top course, corrections can be made at less cost to the Developer. It should be noted however, heavy truck traffic may damage the base course pavement prior to paving the top course. To alleviate this problem, the base course shall be a minimum 2-½" thick if allowed to sit the winter or construction equipment should be kept off the paved base course until the top course is applied and has been accepted by the Department of Public Works.
- The Owner/Developer of the roadway shall secure an Owner's policy of title insurance in favor of the City of Winooski.
- Partial releases of the bond for water distribution, sanitary sewers, and storm drainage will only be made for those continuous sections which pass all required tests.

1.16

### **ACCEPTANCE OF ROADWAY**

The following shall occur where a roadway is to be irrevocably offered by way of dedication to the City:

- The survey map depicting the roadway shall be completed by a Professional Surveyor licensed in Vermont and recorded with the City.
- All pins/concrete markers/other tributes in and along the roadway must be installed before acceptance of the roadway and no later than the date of the offer of dedication.
- The owner of the roadway shall secure an owner's policy of title insurance in favor of the City of Winooski.
- Counsel for the owner of the roadway shall certify that all permits and all acceptances for construction of the road have been secured and that the roadway and any water, storm, or sewer lines situated within the roadway have been

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constructed in accordance with such permits/approvals.

- The Warranty Deed transferring the roadway to the City shall contain a metes and bounds description of the roadway and reference to the recorded survey map.
- The Developer shall pay the reasonable costs of the City in reviewing the instruments of transfer and compliance with the foregoing conditions.

### **ENGINEERING SERVICES DURING AND AT THE END OF CONSTRUCTION**

1.17 The Developer's Design/Project Engineer shall inspect the project during construction for the purpose of verifying tests and that the project was constructed in conformance with the approved plans and project documents.

### **SUBMITTAL OF AS-BUILT DRAWINGS**

1.18

A Certificate of Compliance will not be issued for any portion of a project involving an extension of utilities or a road until all testing/inspection certifications have been submitted and an initial set of record drawings have been accepted by the City.

Record drawings should include the following information:

#### **1.18.1 Sanitary Sewers**

- Accurate locations, depths, pipe materials, sizes, and slopes, of all sanitary sewer lines, sewer service lines at the main and at the Right-of-Way, building connections, cleanouts, and manholes including rim elevations, invert elevations and distances between manholes.
- Results of leakage tests on all pipelines and manholes.
- Results of deflection and lamping tests.
- Results of sewerline video, if available.
- Documentation of three (3) distance tie measurements for each structure.

#### **1.18.2 Water Distribution**

- Accurate locations of all water lines, service lines, valves, and appurtenances.
- Accurate measurements and depths to all valves, tees, bends, curb stops, and any other fittings from permanent fixtures such as telephone poles,

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hydrants, buildings, transformers, etc.

- All curb boxes shall be marked with stakes so they can be easily located before building services are connected.
- Results of hydrostatic, leakage, and disinfection tests on all pipelines.
- Documentation of three (3) distance tie measurements for each structure, fitting, and appurtenance.

### **1.18.3 Storm Drains**

- Depth, size, location, slope, and type of all storm drain lines and culverts, including underdrains and services along with elevations.
- Location and rim and invert elevations of all catch basins and drainage manholes.
- Location and details for all storm drainage facilities, such as ponds and other stormwater treatment facilities.
- Location of all drainage ways, water courses, etc.
- Location and width of drainage easements.
- Results of pipeline video, if available.

### **1.18.4 Highways**

- Accurate locations of all streets, culverts, and other facilities.
- For streets, the following information shall be shown:
  - Width of pavement from curb to curb or shoulder to shoulder;
  - Right-of-way dimensions for streets;
  - Width of sidewalks, bike paths and easements;
  - Location of street lights and conduits, including depth;
  - Location of driveways;
  - Location and size of planter islands, if any
  - Typical cross-section of streets as installed with date of completed construction;
  - Location of all underground electric, gas, cable, telephone lines, and crossing sleeves.
- Results of all sieve analyses, compaction, and bituminous pavement tests.

### **1.18.5 Record Drawings**

Record drawings are required for both subdivision and site development in the City of Winooski. Record drawings shall include all items as defined on the City's As-built Check List.

**1.18.6 Final Drawings**

After review of final drawings by the Department of Public Works, a final set of record drawings, consisting of paper, PDF, ArcGIS, and AutoCAD formats, shall be submitted to the City within sixty (60) days of the completion of a project and shall be signed and sealed by the Design/Project Engineer, a P.E. licensed in Vermont. The record drawings shall also contain a stamped and signed statement by a Professional Surveyor licensed in Vermont that all property corner markers and roadway monuments have been set in accordance with the accepted property plat.

**END OF SECTION**

SECTION 2

SANITARY SEWER SYSTEMS

**SECTION 2 SANITARY SEWER SYSTEMS****GENERAL**

2.1 It is not intended by the City of Winooski that this "Section" be a complete set of specifications. It is to be used as a basic standard for any person planning to work in the City sanitary sewer system. All items included shall be acceptable to the Department of Public Works and any items not listed will require written acceptance by the Director of Public Works before installation. Failure to receive City acceptance of the materials and methods prior to their incorporation into the system shall leave the person having said work done liable for the replacement of those substandard materials with acceptable materials at his/her expense.

The person(s) proposing extensions or alterations to the existing sanitary sewer system shall be responsible for complying with all applicable rules, regulations, and ordinances (local, state, federal). Said persons shall submit all necessary documentation, including but not limited to, plans, details and drawings, specifications, permits and applications, and shall have obtained all acceptances and paid all applicable fees.

All new sanitary sewer lines will be subject to the current Sewer Use Ordinance and any amendments thereto.

The Developer shall hire at his/her expense the Design/Project Engineer who shall be on site during construction to see that sanitary sewer line construction is completed according to the approved plans and specifications. No pipe shall be covered unless approved by the Design/Project Engineer. All pipelines and manholes shall be tested by an accepted method and to the standards of the industry. Upon completion of work and before any portion of the sanitary sewer is used, the Design/Project Engineer shall submit to the City a certification report stating that the system has been installed in conformance with the accepted plans and appropriate tests have been passed. Copies of all tests and test results shall be submitted to the Department of Public Works.

All gravity sewer systems shall be designed within an existing City Highway, State Right-of-Way, or a proposed Right-of-Way or easement to the City. Sewer pump stations and force mains will not be accepted by the City, nor will costs of operation, maintenance, or replacement be borne by the City, with possible exceptions at the discretion of the Department of Public Works.

## **MATERIALS**

### **2.2.1 Manholes**

#### **2.2**

Pre-cast reinforced concrete manholes shall conform to ASTM specifications C478 (latest edition). Concrete shall be Class A, 4,000 psi reinforced to ASTM specifications. The base shall be monolithic and all sections and joints shall be sealed with bitumastic double seal. All precast sections shall be indelibly marked on the inside with the date of manufacture and the manufacturer's name or trademark.

Manholes shall be capable of handling an 8 ton (H-20) loading without failing.

Cut outs for pipe entries shall be provided and will be sealed with lock-joint flexible manhole sleeve, Kor-N-Seal joint sleeve or accepted equal.

Manhole steps shall be copolymer polypropylene plastic manhole steps: PS2-PF-SL by M.A. Industries, Inc. and shall be placed vertically 12" center to center. Steps shall be a minimum of 10" wide, plus foot stop, and shall be imbedded to meet load requirements of 300 lbs. applied point loading at maximum stress and pull out of 2500 lbs. applied at center of rung.

Manhole frames and covers shall be 30" in diameter as manufactured by East Jordan Iron Works, Model No. 1320 or accepted equal, and shall have the word "SEWER" cast into the cover. They shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects, and shall be smooth and well cleaned by shot-blasting. Materials used in the manufacture of casting shall conform to ASTM A48, Class 30, or better for gray iron, or ASTM A536 for ductile iron.

If manhole is in an area subject to severe runoff or flooding, a watertight cover and frame by East Jordan Iron Works or accepted equal shall be used.

Prior to repaving roadways, steel extension rings shall be installed as necessary to maintain the frame and cover at grade. ASTM 36 Hot Rolled Steel shall be used.

**2.2.2 Pipe**

- PVC (Polyvinyl Chloride)  
Sewer pipe shall conform in all respects to the latest revision of ASTM specifications D-3034, Type PSM, Polyvinyl Chloride (PVC) Sewer Pipe and Fittings, SDR 35. Wall thickness of all PVC pipe shall meet ASTM specifications for SDR 35 pipe. All pipe and fittings shall be clearly marked as follows:
  - Manufacturer's name and trademark;
  - Nominal pipe size;
  - Material designation 12454C PVC;
  - Designation ASTM D-3034 or F679.

Joints shall be push-on type using elastomeric gaskets and shall conform to ASTM D-3212. The gaskets shall be factory installed.

Any pipe or fitting having a crack or other defect or which has received a severe blow, shall be marked "rejected" and removed at once from the work site.

**2.2.3 Service Connections**

For new installations, all service connections shall utilize manufactured PVC SDR 35 gravity sewer fittings. PVC service wyes shall be installed for each new 6" service connection and the materials shall be constructed in accordance with ASTM D-3034. Connection to new or existing sewer mains shall utilize rigid, gasketed couplings; no Fernco type couplings shall be utilized unless specifically allowed in writing by the Department of Public Works. Field fabricated, saddle type connections are not acceptable for connection to new or existing sewer mains.

**2.2.4 Wastewater Pump Stations**

All private pump stations shall be designed and constructed in accordance with the State of Vermont Environmental Protection Rules (EPR), latest edition, and shall include the following appurtenances at a minimum:

- Battery operated Klaxon audio alarm;
- Autodialer with 8 channels with alarm light;
- Elapsed time meters for each pump;

- Alternating switch selector;
- Seal failure indicator light;
- Main power disconnect;
- Lightning protection;
- Emergency power connector compatible for a generator;
- Pressure transducer level control system with backup floats;
- Junction box in manhole for pump disconnection;
- Heater with thermostat;
- Run light;
- Transfer switch in control panel;
- Explosion proof lighting fixtures and 15 amp 120 VAC convenience outlet;
- Pump by-pass capability;
- Provisions for odor control, if needed;
- Wet well mechanical ventilator;
- Trash basket or rack, if required;
- Platform with grating;
- Maintenance contract;
- Complete operation and maintenance manual;
- Maintenance contact person;
- Controls shall be located above grade.

**2.3****INSTALLATION****2.3.1 PVC Pipe**

All field cuts are to be made at a ninety (90) degree angle. The cut end shall be beveled to the same as the factory bevel and all interior burrs shall be removed. A homing mark shall be placed on the pipe before assembling. The pipe installed under this specification shall be installed so that the initial deflection is less than five (5) percent.

PVC pipe shall not be installed when the temperature drops below 32 degrees Fahrenheit or goes above 100 degrees Fahrenheit without prior Department of Public Works approval. During cold weather, the flexibility and impact resistance of PVC pipe is reduced. Extra care is required when handling PVC pipe during cold weather conditions.

PVC pipe shall not be exposed to prolonged periods of sunlight, as pipe discoloration and reduction in pipe impact strength will occur. Canvas or other opaque material shall be used to cover PVC pipe stored on site.

### **2.3.2 Pipe Bedding**

For PVC gravity sewers, the bedding material shall consist of ¾" crushed stone, VTrans item 704.02B. The bedding material shall extend from the trench bottom at 6" below the pipe invert to 6" above the top of the pipe.

## **TESTING PROCEDURES**

Sanitary sewers and structures shall be tested for soundness, deflection, and tightness 2.4 as follows:

### **2.4.1 Low Pressure Air Test**

The low pressure air test shall conform to the requirements and procedures set forth as follows:

1. Test is to be conducted between two (2) consecutive manholes, as directed by the Design/Project Engineer.
2. The test section of the sewer line is plugged at each end. One of the plugs must be tapped and equipped for the air inlet connection for filling the pipeline from the air compressor.
3. All service laterals, stubs, and fittings into the sewer test section should be properly capped or plugged and carefully braced against the internal pressure to prevent air leakage by slipping and blowouts.
4. Connect air hose to tapped plug selected for the air inlet and then connect the other end of the air hose to the portable air control equipment in which to monitor the air entry rate to sewer test section and the air pressure in the pipeline.
5. The air control equipment includes a shut-off-valve, pressure regulating valve, pressure reduction valve, a monitoring pressure gage having a pressure reduction valve, and a monitoring pressure gage having a pressure range from 0 to 5 psi. The gage shall have minimum divisions of 0.10 psi and an accuracy of +0.04 psi.
6. Connect another air hose between the air compressor (or other source of compressed air) and the air control equipment. This completes the test equipment set up. Test operations may commence.
7. When a constant pressure of 4.0 psig is reached, throttle air supply to maintain the internal pressure above 3.5 psig for at least five (5) minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall. During this stabilization period, it is advisable

- to check all capped and plugged fittings with a soap solution to detect any leakage at these connections.
8. If leakage is detected at any cap or plug, release the pressure in the line and tighten all leaky caps and plugs. Then start the test operation again by supplying air. When it is necessary to bleed off the air to tighten or repair a faulty plug a new five (5) minute interval must be allowed after the pipe line has been refilled.
  9. After the stabilization period, adjust the air pressure to 3.5 psig and shut off or disconnect the air supply. At 3.5 psig commence timing with a stop watch until the line pressure drops to 2.5 psig. The time required for a pressure loss of 1.0 psig is used to compute the air loss. Most authorities consider it unnecessary to determine the air temperature inside the pipe line and the barometric pressure at the time of the test.
  10. If the time, in minutes and seconds, for the air pressure to drop from 3.5 to 2.5 psig is greater than that shown in Table 2.1 for the designated pipe size, the section undergoing the test shall have passed and shall be presumed to be free of defects. The test may be discontinued at that time.
  11. If the time, in minutes and seconds, for 1.0 psig drop is less than that shown in the table below for the designated pipe size, the section of pipe shall not have passed the test; therefore, adequate repairs must be made and the line retested.

**Table 2.1****Low Pressure Air Test – Time Table**

<b>Pipe Diameter</b>	<b>Time</b>
6"	4 min 00 sec
8"	5 min 00 sec
10"	6 min 30 sec
12"	7 min 30 sec
15"	9 min 30 sec
18"	11 min 30 sec

**Notes:**

1. An air pressure correction is required when the prevailing ground water is above the sewer line being tested. Under this condition, the air test pressure must be increased 0.433 psi for each foot the ground water level is above the invert of the pipe.
2. If the section does not pass the leakage tests, the Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, or joint, all at his/her own expense and without extension for completion of

work. Additional tests and repairs shall be made until the section passes the specified test.

3. No more than 1,000 feet of sewer shall be constructed initially without testing. After the initial test, the frequency of testing shall be as determined by the Design/Project Engineer.

#### **2.4.2 Deflection Test**

This test is applicable in sections in which plastic pipe (PVC) has been installed. Requirements and procedures as recommended by the manufacturer and as detailed below shall be followed for the specific pipe material used.

Deflection testing of PVC pipe (flexible) shall conform to the requirements and procedures set forth by the manufacturer but as directed by the Design/Project Engineer. Testing shall take place on all lines designated by the engineer only after the final backfill has been in place at least thirty (30) days. The test shall be conducted using a rigid ball or mandrel having a diameter 95% of the pipe. This "go - no go" deflection testing equipment shall be pulled through the pipe without the use of mechanical pulling devices.

All sewer lines shall be lamped by a Professional Engineer, licensed in Vermont, as witnessed by the Department of Public Works. The maximum limits of vertical deflection for PVC pipe (flexible) shall be 5%. In any area where the deflections exceed 5% (i.e. the mandrel will not successfully pass and the lamping test fails), the trench shall be re-excavated, and the pipe zone backfill and bedding shall be removed and replaced in accordance with the original specifications. If, in the opinion of the Design/Project Engineer and/or the Department of Public Works, the pipe has been damaged, the pipe shall be removed and replaced with new pipe and installed in full accordance with the specifications.

#### **2.4.3 Force Main Hydrostatic and Leakage Test**

After a force main has been completed, the pipe shall be subjected to a hydrostatic and leakage test in accordance with Section 1-A-05(g) and 1-A-05(h) of the Environmental Protection Rules, Chapter One of AWWA C600 (latest edition). The test pressure shall be at least 1.5 times the highest working pressure in the section and a minimum of 50 psi at the highest point along the test section for a minimum two (2) hour duration and not vary by more than 5 psi.

**2.4.4 Manhole Vacuum Test**

After each manhole has been set in place (**but before backfilling**), all inlet and outlet pipes connected, joints and openings sealed and otherwise ready to be backfilled, the Contractor shall perform a vacuum test of each manhole in the presence of the licensed Design/Project Engineer as follows:

1. Set the testing equipment on the top section of the manhole and inflate the compression band to affect a seal between the structure and the vacuum base.
2. Connect the vacuum pump to the outlet port, open the valve, and draw a vacuum of 10" Hg (Mercury).
3. Close the valve and monitor the vacuum gage.
4. The manhole shall pass this test if the vacuum holds at 10" Hg or drops no lower than 9" Hg within the following times shown on Table 2.2.

**Table 2.2****Manhole Vacuum Test**

<b>Manhole Depth</b>	<b>Time</b>
0' – 10'	2 min 00 sec
10' – 15'	2 min 30 sec
15' – 20'	3 min 00 sec

5. If the vacuum drop exceeds 1" Hg during the specified time periods, the manhole shall be resealed on the outside and steps 1 through 4 above shall be repeated until the vacuum holds for the specified time. No interior parging shall be allowed.
6. After the manhole passes the vacuum test, it shall be backfilled carefully so that no leaks are created. If the manhole is disturbed in any way during backfill, it shall again be vacuum tested according to steps 1 through 4 above.
7. The Contractor shall provide the Design/Project Engineer with a written log of each manhole leakage test result.

**END OF SECTION**



SECTION 3

WATER DISTRIBUTION SYSTEMS

## SECTION 3 WATER DISTRIBUTION SYSTEMS

### PREFACE

- 3.1.1.** The Specifications and Details for the Installation of Water Lines and Appurtenances in the City of Winooski (henceforth the Water Specifications) are applicable to all new construction and reconstruction of water infrastructure components within the City's boundaries. Variations from these specifications will not be permitted except as provided herein. In cases where design of a facility is not governed by these specifications, the latest design methods shall be used and included on the plans for review by the City Engineer. All references to the City Engineer herein shall mean the City Engineer or his designee.

### INTRODUCTION

- 3.2.1** The City of Winooski purchases its water from the Champlain Water District (CWD), who are responsible for the supply of water to member communities through transmission mains, storage facilities and pump stations.
- 3.2.1.1** The CWD is a regional water supplier supplying nine different communities consisting of twelve different municipal water systems. The CWD Wholesale Department owns and maintains all pipelines dedicated to the transmission of potable water to the various communities it serves. The CWD Wholesale Department is responsible for the supply of water to all member communities through transmission mains, storage facilities and pump stations.
- 3.2.1.2** The City of Winooski is responsible for the maintenance and repair of its water lines and associated infrastructure including fire hydrants, pressure reducing valves, gate valves, and service lines as defined in this document and appropriate City ordinances, regulations and policies.
- 3.2.2** This document may not be reproduced without the consent of the Department of Public Works.
- 3.2.3** These Water Specifications shall consist of the excavation, installation, backfilling, and testing required for water line construction. It shall also include valve, tee, hydrant, elbow, reducer, service line, and other appurtenance information that are necessary for a complete water

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distribution system. Materials and installations shall be inspected and approved by the Department of Public Works before potable water is supplied to the project infrastructure.

**3.2.4** These Water Specifications are considered the minimum acceptable standard specifications for the City. The acceptability of any deviations from these specifications shall be determined by the Department of Public Works, or the CWD Chief Engineer and/or Transmission System Director in the case of CWD owned lines or facilities. Private water lines and appurtenances shall be designed to the same standards as public water lines and appurtenances.

**3.2.5** In cases where the design of an item is not specifically covered by these specifications and details, the submittal of such an item shall include sufficient information for a determination of acceptability by the Department of Public Works. At a minimum, information will include a description of the item, detailed materials information or reference to a universally recognized standard (AWWA, ANSI, etc.), a description of the methods to be used for construction and any testing necessary to verify the quality of the installation. The City Engineer may also require a list of locations and contact personnel where the item has previously been installed or the procedure used. It is not the intent of these specifications to prevent alternative solutions; however the burden of proof for acceptability of alternate solutions lies with the proponent.

### 3.3

#### REFERENCES

**3.3.1** All references to AWWA, ANSI, or the VT Water Supply Rule shall be to the most recent edition available.

### 3.4

#### PLANS AND DESIGN

**3.4.1** One complete set of construction drawings and specifications for the proposed water system expansion or rehabilitation shall be prepared and submitted for review by a licensed professional engineer registered in the State of Vermont to the City Engineer, and in the cases of connection to the CWD transmission main, the CWD Chief Engineer and/or Transmission System Director. Drawings shall be on a detailed, workable print, and drawn to scale. Drawings shall contain a location map, plan and profile, type of materials to be used, locations of existing water lines and hydrants, valves, thrust blocks, air relief valves, blow offs, pressure reducing valves and other appurtenances necessary for complete installation. Details shall be provided with all drawings.

- 3.4.2** Any project involving tapping the water main for services larger than one and one-half (1½) inches shall have drawings submitted to the City Engineer for review. Any project that may impact a CWD Transmission Main shall have drawings submitted to the City Engineer and CWD Chief Engineer and/or Transmission System Director for review.
- 3.4.3** Construction drawings and specifications should be submitted for review during the preliminary design stage. At each stage of a project's development, engineering plans shall be submitted for review to determine compliance with these and all other Public Works Specifications. The level of engineering detail required for approval generally increases with each stage of project approval. All construction drawings and specifications shall have a note stating, "All work to be performed in accordance with the City of Winooski Water Specifications." Upon receipt of acceptable final engineering plans the City Engineer will approve the plans for construction.
- 3.4.4** No water main extensions or alterations will be constructed within the City without the written approval of the City Engineer. All contract documents shall meet these specifications as well as any of the applicable components of the City of Winooski Water Use Ordinance, which can be found in Chapter 24 of the Winooski Municipal Code entitled "Water Use".
- 3.4.5** The applicant must state fully and truthfully the purposes for which the water shall be required, and shall agree to conform to the City of Winooski Water Use Ordinance and these Water Specifications. No person supplied with water from the City's water distribution mains will be entitled to use it for any other purpose other than those stated on the permit. Permits for any other water use shall require a separate permit application.
- 3.4.6** The project shall be constructed, completed, maintained, and operated in accordance with the approved plans. No changes shall be made in the project without the written approval of the City Engineer. All water mains, appurtenances and other materials, and construction methods shall conform to the most recent edition of all applicable AWWA, ANSI, State and Local codes, standards and regulations, and the VT Water Supply Rule. In the case of conflict between these construction details and specifications and a code or regulation, it shall be resolved to the satisfaction of the City Engineer.
- 3.4.7** The applicant, developer or owner of record shall procure all permits, licenses, and easements that may be required to complete planned
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construction, including payment of all applicable fees, and shall comply with all conditions set forth in each permit.

- 3.4.8** At least seven (7) days before the start of actual construction of any utilities or improvements in the City, the applicant, engineer, owner, or contractor shall notify the City Engineer of his intent to proceed, and shall arrange a preconstruction meeting with the City Engineer, applicant, engineer, and the contractor to discuss the project if required.
- 3.4.9** The applicant, developer or owner of record, beyond gaining approval of the contract documents by the City Engineer, shall be responsible for any permit issued or work completed under these specifications. The project applicant, or owner shall keep the City Engineer advised of the address to which bills, notices, and other communications are to be delivered, and shall provide an emergency contact list effective throughout the construction period.
- 3.4.10** All water mains, including those not designed to provide fire protection, shall be sized after a hydraulic analysis based on flow demands and pressure requirements. The system shall be designed to maintain a minimum pressure of 20 psi at ground level at all points in the distribution system under all conditions of flow. The normal working pressure in the distribution system should be approximately 60 psi and not less than 35 psi. (VT Water Supply Rule, 8.1.1). The City Engineer may require the installation of Pressure Reducing Valves (PRVs) depending on system location.
- 3.4.11** All service connections and water mains shall be buried to a depth of six feet (6') to the top of the pipe unless modified by the City Engineer.
- 3.4.12** Water main extensions shall be continuous to the furthest property line of the project. A "dead-end" water main shall have a fire hydrant or flushing hydrant installed at the end, as required in these specifications, unless approved otherwise by the City Engineer.
- 3.4.13** In general, and unless stated otherwise in the City of Winooski Water Use Ordinance, easements of sufficient width of a minimum dimension of lateral offset on both sides of the pipe equal to depth to bottom of pipe plus five (5) feet shall be provided at locations acceptable to the City if required. Easements for gas, telephone, electrical, and cable TV and private utilities should be located outside of the street right of way and away from water lines and appurtenances when feasible. The easement deed shall contain language that specifically indemnifies, and holds the
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City harmless from any obligations, liabilities or claims arising from the existence of such easement or the construction of any utility within the easement, as well as wording preventing the construction of buildings or structures above the water line or within the water line easement.

**3.4.14** All construction documents shall consider adequate fire protection and domestic service pressure. In the event a new extension cannot meet those requirements, then the applicant or developer shall loop the waterlines, add a storage tank, provide booster pumps, or make other approved provisions to meet the requirements. The requirement to install the above appurtenances does not imply that the City shall take ownership of the required provisions. Ownership shall be determined within the course of plan reviews, acceptance of the final work, and in accordance with City policies and requirements.

**3.4.15** There shall be no connection between the water distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminating materials may be discharged or drawn into the system (VT Water Supply Rule, Chapter 21). In general, requests for irrigation purposes directly off the distribution system shall be denied.

**3.4.16** The City Engineer shall be notified in advance to inspect all mechanical joint fittings, main line taps, appurtenances, thrust blocks, and water line crossings prior to occurrence or backfilling.

**3.4.17** The contractor or Project/Design Engineer shall notify the City Engineer no less than two (2) working days in advance of any proposed testing of completed mains. Attendance of all testing is at the discretion of the City Engineer; however, the absence of City representatives does not relinquish the above requirements. No testing shall be performed on weekends or City observed holidays.

**3.4.18** When unexpected subsurface conditions are encountered, the Contractor must report the changed conditions to the Design/Project Engineer who shall in turn report the situation to the City Engineer before the work is allowed to proceed.

**3.4.19** With regard to reconstruction of existing facilities, it is the goal of the City to make improvements to upgrade the water system infrastructure to the standards outlined in these specifications.

**3.4.20** If at any time during construction the City Engineer feels that improper materials, equipment or labor is being utilized he may direct

verbally and/or in writing that the situation be corrected at once. This may cause further construction to be terminated pending compliance.

- 3.4.21** The City Engineer reserves the right to direct the contractor to “dig up” any installation not meeting these requirements or that have been installed without prior approval or inspection, at the contractor’s expense.
- 3.4.22** Water main valves and curb stops shall be within the City Right-Of-Way (R.O.W.) unless otherwise specified. Appurtenances outside the R.O.W. shall have an approved permanent easement for repair and maintenance.
- 3.4.23** No new parallel underground utility should be designed or installed within four (4) feet of the water main from either side, or above the water main from the bottom to the finish grade. The exceptions of storm sewer and sanitary sewer are only as allowed by these specifications and the VT Water Supply Rule. No new building or structure shall be built above the water line or within the water line easement. All design shall take into consideration future excavations of the water line and appurtenances around all stormwater and sewer structures.
- 3.4.24** Upon completion of the of the water system construction project, “Record Drawings” shall be supplied to the City Engineer in the form of one (1) hard copy and one (1) electronic copy in Auto-CAD.DWG Version 2003 Format (.DWG) or newer as requested by the City Engineer. All Record Drawings are to include valve ties, and manufacturer make and casting date for all gate valves. Location ties for all curb stops and water shut offs (WSOs) shall also be provided on the Record Drawings. The City may require the submittal and/or O&M manuals in electronic (pdf) format on given projects.
- 3.4.25** For one year from the date of final project completion, the applicant, developer/contractor will be responsible for any necessary repairs or corrections as part of the project warranty. A final inspection shall not take place until after the City Engineer has determined that the water system Record Drawings have been received and all required improvements have been satisfactorily completed. Water system Record Drawings shall be prepared and submitted to the City Engineer at the completion of the water system construction. The City Engineer shall conduct a walk-through inspection of the construction project and identify deficiencies. The contractor shall repair, replace or retest promptly as directed by the City Engineer and without charges to the City, all work, equipment, materials or parts, which are identified as deficient.
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- 3.4.26** Prior to starting the project and in the absence of any statutory requirements the developer/contractor will enter into an agreement for the initial routine maintenance and warrantee of the work through final completions, acceptance and transfer of ownership.

### **DUCTILE IRON PIPE**

#### **3.5**

- 3.5.1** Pipe shall be ductile iron with a minimum diameter of eight (8) inches unless waived in writing by the City Engineer, and conform to current AWWA C151 or ANSI Specification A21.51. Larger diameter mains will be required if necessary to allow withdrawal of the required fire flow while maintaining the minimum pressure specified in the VT Water Supply Rule, Chapter 21. Any proposed departure from minimum requirements shall be justified by hydraulic analysis and future water use assessment, and will be considered only in special circumstances (VT Water Supply Rule, Chapter 21).
- 3.5.2** Push-on joint pipe shall be minimum thickness class 52. Pipe shall be cement mortar lined on the inside in accordance with ANSI A21.4 and AWWA C104 except that the cement lining thickness shall not be less than one-eighth (1/8) inch. A plus tolerance of one-eighth (1/8) inch will be permitted.
- 3.5.3** Ductile iron pipe shall have an exterior petroleum asphaltic coating in accordance with AWWA C151/ANSI A21.51
- 3.5.4** Four-inch (4") and six-inch (6") pipe shall have no less than two (2) brass wedges installed at each joint. Eight-inch (8") and larger pipe shall have no less than three (3) brass wedges installed at each pipe joint. Conductivity bonds may be installed in place of wedges.
- 3.5.5** When a pipe material is specifically noted on the approved project drawings, the contractor/developer shall not have the option of utilizing any other pipe material. Galvanized pipe or fittings shall not be used within the City distribution system.
- 3.5.6** The City Engineer reserves the option of requiring polyethylene pipe sleeve encasements and/or alternate pipe materials in known or suspected corrosive soil conditions. Soil corrosiveness testing may be required at the expense of the Developer.

**POLYVINYL CHLORIDE (PVC) PIPE**

3.6

- 3.6.1** Pipe shall be PVC with a minimum diameter of eight (8) inches and conform to AWWA C900 or ANSI A21.51, latest editions. Larger size mains will be required if necessary to allow withdrawal of the required fire flow while maintaining the minimum pressure specified in the VT Water Supply Rule, Chapter 21. Any proposed departure from minimum requirements shall be justified by hydraulic analysis and future water use assessment, and will be considered only in special circumstances (VT Water Supply Rule, Chapter 21).
- 3.6.2** PVC pipe may be used in place of Ductile Iron pipe only when approved during plan reviews or by the City Engineer. PVC pipe shall be DR 14; class 200 with push on joints, unless otherwise specified. Generally, PVC pipe may be required in areas with known or suspected corrosive soil conditions. The installation of PVC pipe shall comply with the installation procedures found in AWWA C-605, latest edition. PVC pipe shall not be installed in locations where there is a likelihood of low molecular weight petroleum products or organic solvents or their vapors being present.
- 3.6.3** PVC pipe shall be installed with an approved tracing wire accessible in a Buffalo Box, Water Tracer Wire Access Box, or approved equal, at approved locations. The tracing wire shall be placed at the top of the sand blanket over the pipe. The wire shall be placed in a one (1) inch PVC conduit under roadway and sidewalk crossings. Tracing wire shall be a blue coated, solid tracer wire, 12 gauge minimum, and shall run continuously for the full length of the pipe line, surfacing only in approved access boxes. If splicing is necessary, a direct bury splice kit is required.
- 3.6.4** PVC pipe shall neither be stored outdoors nor exposed to direct sunlight for periods of one year or more after delivery. For extended periods of storage PVC pipe shall be covered with canvas or other opaque material with provision for adequate air circulation.
- 3.6.5** Pipe shall be stored in unit packages on flat surfaces to avoid bending.
- 3.6.6** Gaskets shall be protected from excessive exposure to heat, direct sunlight, ozone, oil, grease, and other contaminants.
- 3.6.7** Restraining mechanisms and fittings for PVC pipe shall be pressure-rated in accordance with ASTM F1674. Thrust restraints shall be provided for each dead end, valve, bend, hydrant, reducer or fitting where changes in pipe diameters or directions occur according to these specifications.
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Thrust restraints shall include wedge style retainer glands and thrust blocks, per these specifications.

- 3.6.8** Fire hydrants connected to PVC water mains shall be installed with the appropriate length of six (6) inch Ductile Iron Cement Lined, Class 52 pipe, polyethylene encasement, secured to the gate valve and hydrant with approved retainer glands, the fire hydrant and appropriate thrust block.
- 3.6.9** Service connections made to PVC mains shall require a tapping saddle. Only tapping saddles manufactured specifically for PVC pipe shall be used. The service saddle shall be designed to provide a drip tight connection. The body shall be Teflon or Epoxy coated with stainless steel strap(s), bolts, nuts, and mechanisms for attaching to the pipe barrel. The maximum outlet size for a service saddles shall be two (2) inches. Narrow U-Bolt type straps and saddles having lugs that dig into the pipe wall shall be prohibited.

### **DUCTILE IRON AND PVC WATER MAIN INSTALLATION**

#### **3.7**

- 3.7.1** The installation of Ductile Iron (DI) water lines shall conform to AWWA Standard C600, current edition.
- 3.7.2** The water main shall be laid and maintained on lines and grades established by the contract documents for the project, or as defined within these specifications, which ever has been approved. Fittings and appurtenances shall be installed at the required locations per the approved plans and/or these specifications, unless approved otherwise by the City Engineer. Prior to excavation, an investigation may be required to determine the location of existing underground structures and conflicts.
- 3.7.3** Discharges from the trench shall be directed away from the trench to prevent trench instability. Excavated materials shall be placed in a manner that will not obstruct the work; nor endanger workers or the public; nor obstruct sidewalks, driveways, roadways, or other structures. Pavement and road surfaces shall be removed as part of the trench excavation. The amount removed shall depend on the width of the trench excavation required for the installation of the pipe and appurtenances, unless otherwise approved by the City Engineer. Sawing, drilling, cutting or chipping shall be used to ensure the breakage of pavement in straight lines. Trenches shall be wide enough to permit the placement of a trench box, sheeting, bracing, and appurtenances as required by safety regulations and standards (e.g. OSHA).

- 3.7.4** When excavation of rock is necessary, all rock shall be removed to provide a clearance below the pipe, valves, and fittings of six (6) inches and on all sides of at least eighteen (18) inches. After excavation is completed, structural fill shall be placed on the bottom of the trench over the rock to the appropriate depths, then leveled and compacted. Specific clearances shall be maintained between the bottom of the pipe and any part, projection, or point of rock, boulder, stone of sufficient size and placement that could cause a fulcrum point or point load on the pipe.
- 3.7.5** If the trench passes over a previous excavation, the trench bottom shall be sufficiently compacted to provide support equal to that of the native soil, or conform to other regulatory requirements, in a manner that will prevent damage to both the new and underlying installation.
- 3.7.6** When the excavated material is found to include ashes, cinders, refuse, organic material or other unsuitable or deleterious material, this material shall be removed to a minimum of at least six (6) inches below the bottom of the pipe. The removed material shall be replaced with clean, approved, stable structural fill. Where potential corrosive materials are encountered, polyethylene encasement shall be used to protect DI pipe as approved.
- 3.7.7** The proper implements, tools, and facilities shall be provided and used for the safe and convenient performance of pipe installation. All pipe, fittings, valves, and hydrants shall be lowered carefully into the trench using a backhoe, crane, ropes, slings, or other suitable tools or equipment, in such a manner as to prevent damage to materials, protective coatings and linings.
- 3.7.8** All pipe, fittings, valves, hydrants, and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for final disposition.
- 3.7.9** Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tool, clothing or other materials shall be placed in the pipe at any time.
- 3.7.10** When pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means that may be specified. When practical, the plug shall remain in place until the trench is pumped completely dry. All precautions shall be made to prevent flotation of the pipe in the trench.
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- 3.7.11** All dead ends of new mains shall be closed with plugs or caps; such dead ends shall be equipped with suitable blow-off facilities as specified in the plans.
- 3.7.12** The installation of PVC water lines shall conform to AWWA Standard C605, latest edition.
- 3.7.13** PVC pipe shall be stored in unit packages on level ground and should not be stacked more than two units high. The weight of the units should be supported by supports holding the pipe, not the pipe itself. Pipe that will not be installed immediately shall be covered, allowing for the circulation of air through the pipe.
- 3.7.14** Pipe shall be placed in trenches with ropes, skids, or slings. The pipe shall not be permitted to take an unrestrained fall into the trench bottom. Service taps shall not be installed on small diameter pipes that have been bent into a curved shape as allowed by the pipe manufacturer.
- 3.7.15** The assembly line on PVC pipe shall not be used as an indicator when assembling to Ductile Iron fittings. No attempt shall be made to deflect joints made to any fittings.
- 3.7.16** All new water mains shall be filled at a maximum velocity of one (1) foot per second while venting air.
- 3.7.17** See Detail W-1: Typical Water Trench Detail.

**3.8****FITTINGS**

- 3.8.1** Ductile iron fittings shall conform to ANSI/AWWA C110/A21.10, 350 pounds-per-square-inch (psi) working pressure. Ductile iron fittings larger than twelve (12) inches shall have a standard body length. Ductile iron fittings shall be rated for 250 psi. Twelve (12) inch and smaller shall be rated for 350 psi. All ductile iron compact fittings shall conform to AWWA/ANSI C153/A21.53 standards.
- 3.8.2** Pipe shall be inserted squarely into all fittings. No deflection will be allowed from any hydrant, tee, valve, or bend.
- 3.8.3** Anchor tees (aka: hydrant tees and Swivel tees) shall be Class 350 Ductile Iron, cement lined, conforming to ANSI/AWWA C110/A21.10, C111/A21.11, and C104/A21.4. In lieu of anchor tees, mechanical joint tees may be used if a Foster Adapter is secured to the valve directly to the branch of the tee, with Department approval. If a mechanical joint tee is to be used,

it shall conform to the above referenced specifications. Foster glands shall not be used on pipe larger than eight (8) inches in diameter.

- 3.8.4** Mechanical Joint restraints shall be incorporated into the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron, and have a minimum working pressure of 350 psi. Twist off nuts (i.e. Mega-Lug) or approved equal shall be used to ensure proper actuating of the restraining devices.
- 3.8.5** CWD and/or the City may have specific requirements for retainer glands for all connections on a transmission main.
- 3.8.6** Mechanical joint restraints with twist-off nuts shall be EBAA or Sigma, or approved equal within the City water distribution system.
- 3.8.7** Bolts shall conform to ANSI Specification A21.10.
- 3.8.8** Foster adapters shall be installed in all close-coupled connections of mechanical joint fittings and valves where a positive restraint mechanism is required, with Department approval. Foster adapters shall not be installed directly in hydrant shoes.
- 3.8.9** Pipeline couplings shall conform to AWWA Standards C110 and ANSI A21.10. Mechanical joints connecting pieces of proper diameter shall be installed in accordance with the manufacturer recommendations and at locations directed by the plans or the City Engineer. Approved solid sleeve couplings shall be used when joining new pipe or like materials. Hymax couplings may be allowed when joining dislike pipe materials or new and old pipe connections.

**3.9**

- 3.8.10** All fittings shall be restrained, wrapped in plastic, taped, and have concrete thrust blocks poured in place as defined herein.

**TAPPING SLEEVES AND TAPPING VALVES**

- 3.9.1** The CWD Wholesale Department shall be notified whenever a proposed tap is to be made on any CWD transmission main within the City.
- 3.9.2** See “CWD Specifications and Details for the Installation of Water Lines and Appurtenances” for further transmission main tapping requirements.

**3.9.3** Only approved tapping companies shall be allowed to perform wet taps on any CWD or City water mains.

**3.9.4** Taps shall be a minimum of three pipe diameters away from any joint or tapping site in the water line being tapped. Example: if tapping a 12-inch water line the tapping saddle must be 36 inches away from the nearest joint or tapping site on the 12-inch water line.

**3.9.5** All materials used when tapping for a branch connection or interconnection from any City distribution pipelines shall be specified below.

**3.9.6 Ductile Iron Tapping Sleeves**

**3.9.6.1** All taps on CWD or City owned cast iron, ductile iron, or PVC C-900 transmission mains shall be Ductile Iron tapping sleeves.

**3.9.6.2** Taps on all CWD or City transmission mains shall comply with the "CWD Specifications and Details for the Installation of Water Lines and Appurtenances".

**3.9.6.3** The use of Ductile Iron Tapping Sleeves on City Distribution mains will not be permitted without prior written approval from the City Engineer.

**3.9.7 Stainless Steel Tapping Sleeves**

**3.9.7.1** Tapping sleeves shall be stainless steel with mechanical joint outlets.

**3.9.7.2** The MJ stainless steel tapping sleeve shall meet or exceed all material specifications as listed herein and be suitable for use with standard mechanical joint x mechanical joint resilient wedge gate valves per AWWA C509.

**3.9.7.3** The mechanical joint outlet shall be a one piece casting having a plain end and mechanical joint gland TIG and/or MIG welded a full 360 degrees.

**3.9.7.4** The tapping sleeve shall have a mechanical joining outlet gasket, branch sealing gasket, and complete circle gasket attached to the sleeve at the factory.

- 3.9.7.5** The branch sealing gasket and complete circle gasket shall be contained with stainless steel retaining rings.
- 3.9.7.6** The tapping sleeve shall incorporate Drop-In, Square Neck, Track-Hed Bolts with a minimum of two (2) longer starter bolts.
- 3.9.7.7** The branch opening shall be larger in diameter than nominal to allow the use of a full size cutter.
- 3.9.7.8** All welding shall be passivated so as to return the welded stainless steel to its original state.
- 3.9.7.9** There shall be no paper or plastic adhesive labels attached to the tapping sleeve. Any information on the sleeve shall be stenciled.
- 3.9.7.10** The tapping sleeve shall be factory hydrostatically tested on pipe to a minimum of 300 psi to verify proper fit and weld integrity with zero leakage allowed. Test results shall be available upon request.
- 3.9.7.11** Sleeves shall be Powerseal Model 3490MJ Stainless Steel Tap sleeve with mechanical joint outlet or approved equal.
- 3.9.7.12** Stainless steel tapping sleeves shall be used on Asbestos Cement, Cast Iron, Ductile Iron, and PVC C900 distribution water mains.

### **3.9.8 Tapping Valves**

- 3.9.8.1** Tapping valves shall conform to ANSI/AWWA C509 Standard for Resilient-Seated Gate Valves for Water and Sewerage Systems, latest edition, except as modified herein. Inlet and outlet connections shall be Standardized Mechanical Joint unless specified otherwise on the drawings for the type of pipe required for the branch or lateral pipeline. Each valve shall have the maker's name, pressure rating and year in which it was manufactured cast on the body. Prior to shipment from the factory each valve shall be tested by hydrostatic pressure equal to twice the specified working pressure. Gate valves shall be Mueller, Kennedy, or Department approved equal.
- 3.9.8.2** Valves sixteen (16) inches and smaller shall be bubble-tight, zero-leakage at 200 psi working pressure. Valves shall have non-rising stems, open counterclockwise and provide a two-inch

(2") square operating nut with arrow cast in the metal indicating direction of opening.

**3.9.8.3** All valve body bolts shall be stainless steel. Valve stems shall comply with the Vermont No-Lead law, as required.

**3.9.8.4** Tapping valves sixteen (16) inches diameter and larger shall be installed with their stems horizontal, shall be equipped with rollers, tracks and scrapers, and shall be provided with bypass valves unless otherwise specified.

**3.9.8.5** Buried tapping valves shall be provided with a cast iron or approved equal valve box as required allowing positive access to the valve operating nut at all times. In installations where the depth from grade to top of valve operating nut is greater than six (6) feet, a valve stem riser shall be provided and installed such that the depth from the valve stem riser nut to grade is from four (4) feet to six (6) feet, (minimum length of valve stem riser is two (2) feet). Valve stem risers shall be of high strength stainless steel and of welded construction.

**3.9.8.6** All contractors (or others) who apply to the City and the CWD for water line tapping permits shall submit complete specifications and shop drawings of the tapping material they intend to use.

**3.9.8.7** See Detail W-2: Tapping Sleeve & Valve Detail.

3.10

#### **GATE VALVES – RESILIENT SEAT**

**3.10.1** Valves shall be manufactured to meet all requirements of AWWA Specification C509 or C515, latest editions. Valves twelve (12) inches and smaller shall be bubble-tight, zero-leakage at 200 psi working pressure. Valves shall have non-rising stems, open counter clockwise and provide a two-inch (2") square operating nut with an arrow cast in the metal indicating direction of opening. Each valve shall have the maker's name, pressure rating and year in which it was manufactured cast on the body. Valves shall be mechanical joint on each end, and secured to the adjoining pipe with an approved retainer gland. Prior to shipment from the factory each valve shall be tested by hydrostatic pressure equal to twice the specified working pressure. Gate valves shall be Mueller, Kennedy, or Department approved equal.

**3.10.1.1** Buried valves shall be installed with a two-inch (2") square operating nut and shall be installed with a cast iron or approved equal gate valve box as required to allow positive access to the valve operating nut at all times. In installations where the depth from grade to top of valve operating nut is greater than six (6) feet, a valve stem riser shall be provided and installed such that the depth from the valve stem riser nut to grade is from four (4) feet to six (6) feet, minimum length of valve stem riser is two feet. Valve stem risers shall be of high-strength stainless steel and of welded construction.

**3.10.1.2** Gate valves shall normally be placed a maximum of five hundred (500) feet apart. Tee intersections shall have a minimum of three (3) gate valves connected with the use of foster adapters as approved, or anchor-tees and retainer glands to the adjoining pipe, as stated herein. Cross sections (four way intersections) shall have a minimum of four (4) valves, connected with the use of foster adapters as approved and retainer glands to the adjoin pipe as stated herein. On longer runs of pipe, or for long runs of transmission main, valve separation distance greater than five hundred (500) feet may be approved on a case-by-case basis.

**3.10.1.3** All gate valve body bolts shall be stainless steel. Valve stems shall comply with the Vermont No-Lead law, as required.

**3.10.1.4** See Detail W-2: Tapping Sleeve & Valve Detail, and Detail W-3: Stainless Steel Valve Stem Extension Detail.

**3.11****VALVE BOXES**

**3.11.1** Valve boxes shall be of the three-piece cast iron or approved equal slide type with a minimum inside shaft diameter of five and one quarter (5¼) inches. Valve boxes shall extend from the gate valve to finish grade, and overlap a minimum eight (8) inches at the sliding joint.

**3.11.2** Valve boxes shall not transfer loads onto the valve.

**3.11.3** Valve boxes shall have a cast iron cover marked "WATER".

**3.11.4** The boxes shall be dirt tight with the top of the cover flush with the top of the box rim.

- 3.11.5** Valve boxes shall be brought to finish grade with a minimum two-inch (2") and maximum four-inch (4") paving riser in pavement or concrete surfaces.

### **FIRE HYDRANTS AND HYDRANT BRANCHES**

#### **3.12**

- 3.12.1** Fire Hydrants shall be Mueller Super Centurion 250, Figure A-423, or Kennedy K-81 D, and shall conform to AWWA C502 with the following specifications:

**3.12.1.1** Main Valve Opening: 5 ¼ inches

**3.12.1.2** Nozzle Arrangement: Two 2½-inch Hose Nozzles with National Standard Thread (NST)

**3.12.1.3** One Pumper Nozzle with 5-inch Storz Connection

**3.12.1.4** Inlet Connection: 6 inch Mechanical Joint, "Mega-Lug" or equivalent retaining gland, and concrete thrust block

**3.12.1.5** Operating Nut: Standard 1 ½ inch Pentagon

**3.12.1.6** Direction of Opening: Counterclockwise

**3.12.1.7** Depth of Bury: Six-foot cover. The hydrant shall have at least 15 inches and no more than 21 inches between the bottom of the pumper nozzle cap and the ground.

**3.12.1.8** Drain: The hydrant shall be non-draining or have the drains permanently plugged.

**3.12.1.9** Color: Red enamel

**3.12.1.10** Other: Hydrants shall be compression-type, closing with the pressure. Hose and pumper nozzles shall be quarter-turn type, secured by stainless steel or corrosion-resistant pins or screws. Pressure seals behind nozzle flanges shall be "O" rings. A breakable coupling retained in place by stainless steel or corrosion resistant pins shall make the union between the upper and lower stems. The two-piece traffic flange shall be held in place by nuts and bolts. The upper barrel shall be able to rotate 360 degrees without removing any bolts. Approved hydrant

flags shall be required and placed on each new hydrant at the time of installation. Wherever a traffic hazard appears to exist, curbing and/or bollards shall protect the hydrant except that bollards shall not be permitted within municipal rights-of-ways.

**3.12.1.11** For single-family house subdivisions, there will be at least one hydrant at each intersection and a maximum of five hundred (500) feet between hydrants with a minimum water flow of 500 gallons per minute (gpm) at the flow hydrant with a 20-psi residual pressure at the residual hydrant. Municipal hydrants should be located immediately adjacent to street property lines. A Department approved easement will be required around all hydrants. No new structures or plantings are to be placed within a 20 foot x 20 foot area of any hydrant. All approved subdivisions shall be installed with the same brand, make, and model of fire hydrant within the project limits. Where conflicts with other City Ordinances and these specifications regarding hydrant spacing occur, the more stringent standard shall apply.

**3.12.1.12** Where dead-end mains occur they shall be provided with a fire hydrant if flow and pressure meet minimum requirements. If flows and pressure are not sufficient, then a Department approved flushing hydrant or blow off shall be installed for flushing purposes.

**3.12.1.13** When set in lawn space between the curb and sidewalk, no portion of the hydrant or nozzle cap shall be less than one foot off the gutter face of the curb or edge of the sidewalk. Hydrants shall be a minimum of four (4) feet and a maximum of six (6) feet from the edge of the sidewalk to the closest point on the hydrant when placed behind the sidewalk. In the absence of a curb or sidewalk, no hydrant shall be placed more than six (6) feet from the edge of the pavement. Hydrants shall be located so as to provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians.

**3.12.1.14** Hydrants connected directly to a CWD transmission main shall be owned and maintained by the City in accordance with City ordinances and policies. Ownership shall be from the outlet side of the hydrant isolation valve.

**3.12.1.15** See Detail W-4: Hydrant Assembly Detail and Detail W-5: Hydrant Flag Detail.

**HYDRANT ASSEMBLIES**

- 3.13**      **3.13.1** Hydrant assemblies shall consist of an anchor tee or Swivel Joint Hydrant Tee., a six (6) inch mechanical joint gate valve conforming to the above specifications, the appropriate length of six (6) inch Ductile Iron Cement Lined, Class 52 pipe, secured to the gate valve and hydrant with approved retainer glands, the fire hydrant and appropriate thrust block.
- 3.13.2** Care shall be taken to prevent damage to hydrants and appurtenances during handling and installation. All materials shall be carefully inspected for defects in workmanship and materials; all debris and foreign material cleaned out of the hydrant bowl; all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. All hydrants shall be carefully incorporated in the water main and supported in their respective positions free from distortion and strain. Hydrants shall be set plumb. All hydrants shall be oriented to most efficiently allow fire truck access and connection for emergency purposes. Traffic model hydrants shall be installed so the breakaway flange is not less than two (2) inches or more than six (6) inches above the established grade, according to manufacturer's recommendations. Where feasible, fire hydrants shall not be installed within ten (10) feet of any new or existing light pole, telephone/power pole, gas line, utility box or other utility structure. Hydrant locations are subject to approval by the City Engineer and the City fire department. Installation procedures for fire hydrants can be found in AWWA Standard C600.
- 3.14**      **3.13.3** See Detail W-4: Hydrant Assembly Detail.

**BLOW-OFF ASSEMBLIES**

- 3.14.1** Large diameter blow-off assemblies shall consist of an anchor tee, a six (6) inch mechanical joint gate valve conforming to these specifications, the appropriate length of six (6) inch Ductile Iron Cement lined, Class 52 pipe, all necessary anchor couplings, approved retainer glands, MJ and flanged fittings, and cap. The open end of large diameter blow-offs shall terminate at least eighteen (18) inches above grade.
- 3.14.2** The Department may require the installation of a Kupferle TF-500 two (2) inch or a Kupferle TF-800 four (4) inch blow-off/flushing hydrant at various points on the water line. Blow-off/flushing hydrants are typically required at the end of small diameter water lines that are not designed to support a fire hydrant. Blow-off/flushing hydrants shall be installed

according to manufacturer recommendations, and include the above ground piping as required by the Department.

**3.14.3** Blow-offs shall not be connected to any sewer, submerged in any stream or ditch, or installed in any manner that will permit back siphonage into the distribution system.

**3.14.4** See Detail W-6: 6" or 8" Blowoff Assembly Detail.

### **SERVICE CONNECTIONS**

**3.15**

**3.15.1** Service lines shall be copper from the corporation to the curb stop and from the curb stop to the building, in accordance with the City Water Ordinance, for water services up to and including two (2) inch. Service lines shall be installed so as to run perpendicular, in a straight line from the water main to the curb stop.

**3.15.2** Each service shall consist of a corporation, curb stop, copper tubing and a curb box with a stainless steel service rod. Copper tubing shall be type "K", soft temper, conforming to ASTM B88. The name or trademark of the manufacturer and type shall be stamped at regular intervals along the pipe.

**3.15.3** Copper service pipe shall be one piece from the corporation to the curb stop. The minimum domestic water service for a single-family residence shall be three-quarter ( $\frac{3}{4}$ ) inch. The minimum domestic water service for a duplex shall be one (1) inch. Service sizes for non-residential uses shall be designed in accordance with applicable plumbing codes based on the number of fixtures in the building and/or fire protection flow needs. Additionally, the frictional head loss at the instantaneous peak demand shall be calculated and shall be used in the design. Service lines are required to have pressure calculations performed in the event that a home or building requires water service at a substantially different elevation than the water main to which the service connects in order to prove that minimum pressure requirements are met in accordance with the Vermont Water Supply Rule and other applicable building codes.

**3.15.4** All underground service line valves, fittings, corporations, curb stops, meter tail pieces, elbows, and angle valves shall be manufactured in accordance with AWWA C-800, latest edition. Any part of any service line valve, fitting, corporation, curbstop, meter tail piece, elbow, and angle valve in contact with potable water shall comply with Vermont's Lead in Consumer Products Law, Act 193 and/or Federal requirements,

whichever is greater. No-lead brass fittings shall be Cambridge Brass No-Lead, or Department approved equal. All no-lead brass fittings shall have the manufacturers name or trademark integrally stamped or cast on it. Another marking identifying the “no-lead” brass alloy shall also be cast or stamped on the fitting. Corporations shall have threads per AWWA C-800 Table 7/Figure 2 at the inlet, and a compression type fitting at the outlet. Both inlet and outlet shall be the same in size. Three-quarter ( $\frac{3}{4}$ ) inch and one (1) inch corporations shall be directly tapped into new ductile iron pipe six (6) inch and larger in diameter. Larger size corporations up to two (2) inch shall use a tapping saddle. Corporations shall be used for all taps up to and including two (2) inch. In no instance, except when a tapping sleeve and valve is used shall a tap be made without a corporation. Corporations shall be Cambridge Brass or Department approved equal. Corporations shall be ball valve type with minimum allowable pressure rating of 200 psi.

**3.15.5** A connection made to a pipe that requires a tapping saddle or is not ductile iron will have a body with a suitable outlet, seal, and suitable means for attachment to the main. The body shall be made to conform to the outside configuration of the main. The service saddle shall be designed to provide a drip tight connection. The body shall be Teflon or Epoxy coated with stainless steel strap(s), bolts, nuts, and mechanism for attaching to the pipe barrel. Service saddles with a two (2) inch outlet shall not be used on a two (2) inch main. Service saddles must meet manufacturer’s guidelines and recommendations for specific pipe materials.

**3.15.6** Curb stops shall be a ball valve type with a minimum allowable pressure rating of 200 psi and manufactured in accordance with AWWA C800. The curb stop shall open left, have a positive stop, be full port, provide a drip tight shutoff in the closed position, and be of the tee design or flat design. No curb stop shall have the ability to drain the service line. Both the inlet and outlet of the curb stop shall have compression type fittings. The tee head of the curb stop shall have the provision for the connection of a service rod. Curb stops shall be Cambridge Brass No-Lead, or Department approved equal. The curb stop shall rest on a four (4) inch by eight (8) inch by sixteen (16) inch solid concrete block for support. Curb stops shall be installed just inside the City R.O.W. unless approve otherwise by the Department.

**3.15.7** Curb boxes shall be of sliding adjustable Erie style capable of adjusting from five (5) feet to six (6) feet. The base of the box shall be arch type so as to prevent the box from resting on the curb stop. The adjustable

upper section shall be one (1) inch diameter. Stationary rods affixed to the key of the curb stop with a brass pin shall be thirty (30) inches in length for three-quarter ( $\frac{3}{4}$ ) inch and one (1) inch curb stops and twenty-four (24) inches for large curb stops. Curb box rods shall be stainless steel. The word "WATER" shall be inscribed on the cover of the box. The cover of the box shall have countersunk brass pentagon plug for paved or concrete areas, and standard two holes for grass areas. Curb box couplings and extensions will be the same material as the curb box. Both cover and upper section of the box shall be able to be located with an aqua type metal locator.

**3.15.8** All service connections shall be installed to the curb stop for all building lots before the street is paved.

**3.15.9** Service connections shall be made by installing an approved service line from the curb stop or gate valve, through the cellar wall or floor. A ball valve or angle valve as determined by the Department shall be installed by the Department in accordance with the City's Water Ordinance. The Department will furnish and install the appropriate water meter in accordance with the City's Water Ordinance. The contractor is required to perform all necessary plumbing off the downstream meter connection, including a shut-off, backflow device, and pressure regulator; all installed in accordance with standard plumbing practices or municipal requirements. Meter locations shall meet those requirements stated in the City's Water Ordinance.

**3.16** **3.15.10** See Detail W-7: Typical Water Service Connection Detail.

### **BACKFLOW PREVENTION DEVICES**

**3.16.1** No water service connection shall be approved or maintained by the City unless the water supply is protected as required by State laws and City requirements. The type of protective device shall depend on the degree of hazard that exists. Approved backflow prevention devices shall be located so as to provide containment protection, and may be supplemented with internal protection backflow prevention devices. In general, protection shall be provided by an air gap or a Department approved RPZ or DCV as a complete unit, installed in a horizontal alignment as stated in the City's "Cross Connection Control Policy". A shop drawing detail assembly showing backflow devices and meter placements shall be required by the Department.

**ROCK EXCAVATION****3.17**

**3.17.1** Areas of known or suspected ledge may require subsurface investigation to determine its extent prior to job commencement, at the contractor's expense. A pre-blast survey shall be required prior to any blasting.

**3.17.2** Rock shall be excavated, when encountered, to the lines and grades indicated on the drawings or as directed by the City. Excavated material shall be disposed of and acceptable material shall be furnished for backfill in the space voided by the excavated rock.

**3.17.3** Rock in pipe trenches shall be excavated to a depth not less than six (6) inches lower than the bottom of the installed pipe. When so specified or indicated, or when laying the pipe in an excavated rock area, the trench shall be backfilled with satisfactory pre-approved material listed and approved under Pipe Bedding as outlined herein.

**3.17.4** Blasting shall be in full compliance with all State and Federal laws and local ordinances. Blasting contractors shall take all possible care to avoid injury to persons and damage to property. Rock is to be well covered with blasting mats and sufficient warning given to all persons in the vicinity of the work before blasting. Care shall be taken to avoid damages to utilities or other structures above and below ground.

**3.17.5** All blasting shall be conducted by persons qualified and experienced in drilling and controlled blasting procedures for rock excavation of the types required. Persons responsible for blasting shall be licensed blasters in the State of Vermont and shall have had acceptable experience in similar excavations in rock and controlled blasting techniques. Drillers shall have demonstrated proficiency in collaring and drilling holes precisely. The Department shall be notified in advance of all drilling and blasting around all distribution mains within the City.

**3.17.6** No blasting will be permitted under or adjacent to any street, road, or highway unless permission has been received in writing by the City.

**3.17.7** Contractors shall conform to all municipal, State, Federal and other ordinances and codes relating to the storage and handling of explosives. Particular attention is called to adherence of requirements of electric, gas and other utilities that may be located in the project area.

**3.17.8** Damages and cost of whatever nature resulting from blasting operations shall be borne solely by the contractor.

**3.17.9** If rock below grade is shattered by blasting, caused by holes drilled too deep, or too heavy charges of explosives, or any other circumstance due to blasting, and if such shattered rock does not provide suitable foundation, the rock shall be removed and the excavation refilled with acceptable material.

### **PIPE BEDDING**

**3.18**

**3.18.1** Water lines shall be laid and maintained on lines and grades established by the plans for the project. Pipeline trenches shall be excavated to the width and depths shown on the plan typicals or as defined herein. Pipeline trenches in which pipe is to be laid directly on the trench bottom shall not be excavated entirely by machinery, but shall be finally excavated by hand tools such that the trench shall have a bottom shaped to support the pipe throughout its entire length by firm undisturbed material. Pipeline trenches, for which bedding is required, may be excavated to the required depths using machinery. No pipe shall be laid directly on ledge, hard shale or a very compact glacial till. When excavation of rock is necessary, all rocks shall be removed to provide a clearance below all pipes, valves, and fittings of at least six (6) inches for nominal pipe sizes up to twenty-four (24) inches. When excavation is completed, a layer of appropriate backfill material shall be placed on the bottom of the trench to the appropriate depths, then leveled and tamped. These clearances and bedding procedures shall also be observed for pieces of concrete or masonry and other debris that may be encountered during excavation. In all cases the specified clearances shall be maintained between the bottom of the pipe and appurtenances and any part, projection, or point of material of sufficient size that could cause a fulcrum point or point load. When an unstable trench bottom is encountered and the Department determines that it cannot support the pipe adequately, an additional depth shall be excavated and refilled to the pipe invert with approved material at the contractor's expense. Pipeline trenches shall be dry during the laying of pipe. Wood supports under pipe shall be removed prior to back filling. Pipeline installation procedures can be found in AWWA Standard C600.

**3.18.2** Bedding material shall consist of crushed or natural stone conforming to ASTM D2321.

<u>Sieve</u>	<u>Percent Passing</u>
1" Screen	100%
¾" Screen	100%

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½"	90 – 100%
3/8" Screen	40 – 70%
#4 Sieve	0 – 15%

**3.18.3** Bedding and blanket material shall be Class II material (ASTM D2321) consisting of clean, granular material (sand), particle size limits described as follows:

<u>Sieve</u>	<u>Percent Passing</u>
No. 4	100%
No. 100	30%
No. 200	12%

### **PIPELINE INSULATION**

**3.19**

**3.19.1** Approved waterlines with less than five (5) feet of cover over the crown, that cross a storm sewer, where indicated on the plans, or as required by the Department, shall be protected against freezing by the installation of four (4) inches thick of the highest available density extruded polystyrene insulating sheets or equivalent. Sheets shall be the total width of the trench. The sheets shall be placed six (6) inches above the crown after placement of four (4) inches to six (6) inches of clean medium or coarse sand below the pipe bottom and four (4) inches to six (6) inches above the crown. No less than four (4) inches of clean medium or coarse sand shall be placed directly over the insulation sheets after they are installed. Joints shall be overlapped so there is no gap that will allow frost to penetrate. Care shall be exercised during backfill and compaction over the polystyrene sheets to prevent damage to the sheets. The polystyrene sheets shall meet the comprehensive strength requirements of ASTM D1621-73. In no cases shall the waterline have less than four (4) feet of cover over the top of the pipe.

**3.20**

### **POLYETHYLENE PIPE ENCASEMENT**

**3.20.1** Polyethylene pipe encasement may be required in areas of corrosive soils and shall conform to current ANSI/AWWA C105/A21.5 standards. Minimum material requirements for the polyethylene film shall be high density, cross laminated virgin polyethylene 4 mil film. In lieu of installing polyethylene encasement in known or suspected corrosive soils, the Department may approve the installation of other pipe materials including HDPE and/or C-900 PVC pipe.

**3.20.2** The polyethylene encasement shall prevent contact between the pipe or fittings and the surrounding backfill and bedding material and shall be installed as outlined in Section 4.1 of the above ANSI/AWWA standard. Lumps of clay, mud, cinders, etc., on the pipe shall be removed prior to installation of the polyethylene encasement. During installation, soil or embedment material shall not be trapped between the pipe and polyethylene. Overlap and ends shall be secured with the appropriate adhesive tape. All cuts, tears, punctures, or damage to the polyethylene shall be repaired with the appropriate adhesive tape or with a short length of polyethylene sheet wrapped around the pipe to cover the damaged area, and secured in place. Backfilling around polyethylene-wrapped pipe shall be in accordance with ANSI/AWWA C600.

### **CHECK VALVES**

- 3.21**      **3.21.1** Check valves may be required in certain parts of the distribution system. Where required, check valves:
- 3.21.1.1** Shall be rated for 250 psig.
  - 3.21.1.2** Shall have a Ductile Iron body, bonnet and disc that exceed ASTM A-536 66-45-12.
  - 3.21.1.3** Shall have a fusion bonded epoxy coating inside and out.
  - 3.21.1.4** Shall not have any outside lever and weights or springs.
  - 3.21.1.5** Shall have the disc as the only moving part.
  - 3.21.1.6** Shall have a drop tight shut off pressure as low as 5 psig.
  - 3.21.1.7** Shall be suitable for buried service.
  - 3.21.1.8** Shall have a 100% unobstructed flow area that is free of pockets that can trap debris.
  - 3.21.1.9** Shall have a factory installed flushing actuator that can be furnished as an option.
  - 3.21.1.10** Shall have a ductile iron disc fully encapsulated with Buna N rubber.

**3.21.1.11** Shall have a disc travel to closure that shall not be more than 35 degrees.

**3.21.1.12** Shall have stainless steel hardware.

**3.21.1.13** Shall be American Flow Control Series 2100, or Department approved equal.

### **AIR RELEASE VALVES**

**3.22**

**3.22.1** Air release valves shall automatically release small pockets of air as they accumulate at local high points within the distribution system and be provided at required locations as shown on drawings. Air release valves shall be designed to open positively and vent air to the atmosphere at system pressures up to the maximum working pressure as required by the venting orifice size. Valves shall have a stainless steel float and stainless steel or bronze trim. A brass ball valve shall be provided in the connecting pipe ahead of the valve. Valves shall be A.R.I. D-040, APCO No. 200A or Department approved equal. Orifice shall be three-sixteenth ( $\frac{3}{16}$ ) inches and valve, isolating valve and connection piping shall be one (1) inch unless otherwise specified. An air release valve assembled with interconnecting piping shall have pipe and fittings of sufficient size to prevent clogging and entrapment of foreign materials. The piping shall be installed to allow air to rise to the air release inlet. A shut off valve allowing the air release valve to be isolated shall be installed.

**3.22.2** The open end of an above grade air release venting pipe shall terminate at least twenty-four (24) inches above final grade.

**3.22.3** Automatic air relief valves shall not be used in situations where flooding of the access-way or chamber may occur. All air release valves shall conform to ANSI/AWWA C512 and be installed according to the VT Water Supply Rule, A-8.4.

**3.23**

**3.22.4** See Detail W-11: Air Release Valves and Manhole Detail.

### **PRESSURE REDUCING VALVES**

**3.23.1** Main line pressure reducing valves (PRV's) shall be Ross 40 WR Pilot Operated Pressure Reducing Valve with strainer.

**3.23.2** Pressure reducing valves shall be set horizontally and be connected to a flanged pipe on the incoming side and a dismantling coupling on the downstream side.

**3.23.3** To prevent fouling of the pressure reducing valve during water main filling and flushing, a temporary spool piece may be installed in place of the PRV.

**3.23.4** The adjustment range of the pressure reducing valve must be approved by the Department before ordering.

**3.23.5** See Detail W-12: Meter or Pressure Reducing Valve Vault Plan View Detail, and Detail W-13: Meter or Pressure Reducing Valve Vault Profile View Detail.

## **MANHOLES AND VAULTS**

### **3.24**

**3.24.1** Precast manholes shall conform to ASTM Designation C478 and meet the following additional requirements:

**3.24.1.1** The wall thickness shall not be less than five (5) inches.

**3.24.1.2** Sections shall have tongue and groove joints with butyl mastic rope installed between sections.

**3.24.1.3** The exterior of all sections shall have a bituminous coating.

**3.24.1.4** Drainage from the manhole shall be designed to run to daylight whenever possible. Drainage shall have outlet protection and insect screening.

**3.24.1.5** Top sections shall be eccentric except that the concentric flat top sections shall be used where shallow cover requires a top section less than three feet deep.

**3.24.1.6** Precast bases, cast-in-place bases, or precast bases integral with base sections may be used. Precast bases and cast-in-place bases shall be eight (8) inches thick.

**3.24.1.7** Cement shall be Type II Portland Cement, conforming to ASTM Designation C150.

**3.24.1.8** Ladder rungs be aluminum alloy 6061-T6 in accordance with ASTM designation B221, by Aluminum Company of America or Washington Aluminum Company or equal, conforming to Washington Aluminum Company Model T-14-OR. Rungs shall be set in precast sections during casting of section or grouted with a non-shrink grout. Plastic coated steel ladder rungs secured in the walls of the precast structure shall also be acceptable. Rungs shall be aligned so as to allow access from the top of the manhole to the base in a vertical line.

**3.24.1.9** Brick or masonry shall not be used to raise the manhole frame to grade in roadways.

**3.24.1.10** All sections shall be cured by an approved method. Sections shall not be shipped or manhole rungs subjected to loading until the concrete has attained a compressive strength of 3,000 psi or until 5 days after fabrication, whichever is the longer.

**3.24.1.11** Precast concrete manhole and vault manufacturers shall use link seal products to produce a watertight wall penetration. Where appropriate, double link seals shall be used. All link seal bolts shall be stainless steel. Flexible pipe sleeves are not allowed for pipe connection under pressure.

**3.24.1.12** In no case shall a manhole be constructed such that it bears directly or indirectly on the pipeline or any appurtenances thereof.

**3.24.2** All joints, lift holes, and other openings inside and outside the manhole shall be filled with water plug to prevent leakage.

**3.24.3** See Detail W-9: Check Valve Vault Plan View Detail, and Detail W-10: Check Valve Vault Profile View Detail. See also See Detail W-12: Meter or Pressure Reducing Valve Vault Plan View Detail, and Detail W-13: Meter or Pressure Reducing Valve Vault Profile View Detail.

**3.25**

### **MANHOLE AND VAULT FRAME AND LID**

**3.25.1** All water manholes and vaults shall be provided with ductile iron manhole frames and lids of the size and type as required in the drawings, unless covers of another material are approved by the Department.

**3.25.2** Frame and lid shall be one of the following as approved by the Department:

**3.25.2.1** Standard frame and lid: Non-rocking design with solid lid, Neenah No. R-1077 or equal.

**3.25.2.2** Frost proof: Frost proof frame with solid top and inner lid, machined horizontal bearing surfaces, Neenah R-1758 or equal.

**3.25.2.3** Waterproof frames- bolted lids: Waterproof frames shall have a solid lid with machined bearing surfaces, and sealed with a rubber gasket. Lid shall fasten securely to the frame with countersunk bronze hexagonal-head cap screws. Frame shall be supplied with anchor bolts and bolt holes. Manhole frame and lid shall be Neenah No. R-1915-F (Type L) or equal.

**3.25.2.4** Hinged frame and cover: Hinged frames and covers shall incorporate a blocking feature to prevent accidental closure. The cover must be removable if required. Hinged frames and covers may be used in off road locations, or in traveled ways with approval of the Department. Hinged frames and covers shall be Pamrex, Bilco, or approved equal.

**3.25.2.5** Where no traffic is possible or anticipated, water structures may be accessed via an aluminum hatch by Bilco, or Department approved equal. Aluminum hatches shall be rated for 300 psf minimum and have a minimum clear opening of thirty (30) inches. Aluminum hatches shall have a diamond plate skid pattern on them to provide traction, a locking mechanism to hold the hatch open, and be lockable for security purposes.

**3.25.2.6** Manhole lids for manholes on buried water mains shall have the word "WATER" cast into the top surface.

**3.25.2.7** See Detail W-11: Air Release Valves and Manhole Detail.

### **CONCRETE FOR THRUST BLOCKS**

**3.26.1** Concrete shall be Portland Cement concrete of 3000 psi minimum 28 day compressive strength. ASTM C-94 specification for transit mixed concrete shall control the concrete quality. A maximum water cement

ratio of 6 gallons per sack and a maximum slump of four (4) inches will be allowed.

**3.26.2** Concrete shall be clean and not mixed with other material, including previously prepared concrete products.

**3.26.3** Thrust blocks shall be installed on caps, tees, hydrants, and bends of 22.5 degrees and greater, along with retainer glands on each end.

**3.26.4** Blocking shall be placed on all sides of each fitting in the direction of thrust and not underneath for use as a foundation or support.

**3.26.5** All other bends less than 22.5 degree shall be restrained by use of retainer glands on each end of each bend only.

**3.26.6** The required area of thrust blocks shall be indicated on plan typicals and approved by the Department. Concrete shall be placed against undisturbed soil. Wooden side forms or equal shall be provided for thrust blocks. No backfilling shall be allowed until concrete masonry has set sufficiently. Where directed by the Department or engineer, concrete encasement of the waterline may be made for stream crossings and similar purposes. Where required on the plans or as directed by the Department or engineer, a concrete cradle shall be used to bolster and strengthen the pipe. The Department shall inspect all thrust blocks prior to backfilling.

**3.26.7** Concrete shall not overlap any joints, hence restricting future access to nuts and bolts.

**3.26.8** Prior to pouring thrust blocks, all fittings are to be wrapped in 4 mil Polyethylene.

**3.27**

**3.26.9** See Detail W-14: Thrust Block Requirement Detail, and Detail W-15: Thrust Block Details.

**PROTECTION OF THE PUBLIC AND WORK PERSONNEL**

**3.27.1** Work personnel and the public shall be protected by the Contractor from any and all hazards connected with construction work. Open trenches, materials, or equipment within the limits of the public right-of-way are to be guarded by the use of adequate barricades, flag persons or both. All barricades left in position overnight are to be properly lighted from

dawn to dusk, in accordance with MUTCD requirements. When work narrows the usable pavement, certified flag persons shall be used to aid the flow of traffic so that there will be no undue delays. Temporary construction signs shall be erected in accordance with MUTCD requirements. The Contractor shall be held responsible for the safety of all work persons and the general public and all damages to property from the hazard of open trenches, materials, or equipment at any time of day or night within the working area. All work shall be conducted in conformance with applicable VOSHA regulations.

**3.27.2** Excavated material shall be placed in a manner that will not obstruct the work nor endanger the workers or the public, or obstruct sidewalks, driveways, roadways or other structures without another means of travel.

**3.27.3** All trenching safety standards shall be in conformance with VOSHA regulations. The Contractor shall be solely responsible for any safety violations and fines by State and/or Federal inspectors.

**3.27.4** The City may require the submittal of the Contractor's Company Safety Program prior to the contractor commencing work within the City's public right-of-way.

**3.28****PROTECTION AND REPAIR OF EXISTING UTILITIES**

**3.28.1** The Contractor shall notify DIG SAFE prior to excavation, and otherwise comply with all permit requirements of the City. Wherever culverts, sewers, drains, manholes, catch basins, storm drains, water mains and services, water valves or curb stops, electric, telephone or cable TV conduits or cables, utility poles, overhead lines or any other existing facilities are encountered, they shall be protected and firmly supported by the Contractor at his/her expense, by methods approved by the authority having control of the utility structure, until excavation is backfilled and the existing structures made secure. Injury to such structures caused by or resulting from the contractor's operations shall be repaired at the contractor's expense within a time period that will not place an unreasonable burden on the users. The authority having charge of any particular structure shall be notified promptly to injury to its structure.

**3.28.2** Any water distribution component damaged during excavation shall be replaced with in-kind materials or a material approved by the Department.

**3.28.3** Approval for relocation of any appurtenant structure shall be obtained from the appropriate party and the Department prior to relocation. The Contractor shall be responsible for the work and for providing notice to users before planned interruptions of service.

**3.28.4** All materials used for the interconnection with an existing water main shall be disinfected in accordance with AWWA C-651. Interconnections shall be made so as to have the water service interrupted for as short a period of time as possible.

### **WORK OUTSIDE OWNED PROPERTY LIMITS OR PUBLIC RIGHTS-OF-WAYS**

3.29

**3.29.1** The Contractor shall not without written consent of the property owner, enter into or occupy with persons, tools, materials, or equipment, any private land. In a similar manner, no excavation shall take place within the public right-of-way without first obtaining proper authorization from the City.

**3.29.2** The Contractor shall obtain permission from the Department for any change to the approved plans of the project that may require work outside of the defined areas.

3.30

### **PLAN ERRORS OR OMISSIONS**

**3.30.1** The fact that specific mention of a fixture or of any part of the work is omitted in the project specifications, whether intentionally or otherwise, when the same is clearly indicated on the plan drawings, or is usually and customarily required to complete fully such work as specified, will not entitle the Contractor of the project to consideration in the matter of any claim for extra compensation. Said fixtures, work, or both shall be installed or done the same as if called for both by drawings and by the specifications.

**3.30.2** All work indicated on the plan drawings and not mentioned in the project specifications, or vice versa, and all work and material usually necessary to make the work complete in all its parts, whether or not they are indicated on the drawings or mentioned shall be considered the same as if they were called for both drawings and the specifications.

**GENERAL INSTALLATION**

3.31

- 3.31.1** Contractors shall notify the Department and CWD (when performing work in and around a CWD transmission main) at least seven days prior to any work on the water system.
- 3.31.2** The Contractor shall at all times be responsible for conduct and discipline of his employees and/or any subcontractor or persons employed by subcontractors. All workers must have sufficient knowledge, skill, and experience to perform properly work assigned to them. Tools shall be adequate for the work and in good condition so as to produce good results.
- 3.31.3** Any Contractor who does not maintain local headquarters 24 hours a day must make satisfactory arrangements with the Department to service emergencies or complaints that may occur at night, over the weekends, or when the job is shut down (these arrangements shall include road maintenance and repairs). The Contractor shall provide the Department with emergency telephone numbers of the project superintendent and manager.
- 3.31.4** Installation of all water lines shall be in accordance with the latest version of AWWA C600 or AWWA C605 as applicable.
- 3.31.5** Temporary water lines may be required as appropriate for existing water customers to remain in service until a new main has been tested, disinfected, and accepted by the Department.
- 3.31.6** Upon final acceptance of a new water main, the temporary water main shall be disconnected. At least one week in advance of a planned shutdown of any service line, notices must be delivered to all affected customers. Due to the nature of certain business activity, planned shut downs may be required to be scheduled after normal working hours of the affected customer.
- 3.31.7** Connection to an existing water main shall be done under the supervision of and with the approval of the Department. It is the applicants, developers, or owner of record responsibility to secure ALL necessary connection permits and pay ALL applicable fees to make the connection, and to coordinate all parties involved in the process. The engineer and the Department shall be notified at least two working days in advance of the intended connection time. No existing valves, hydrants, curb stops, etc. shall be operated without prior approval of the Department. Any

damage occurring after the use of any valve operated by the Contractor shall be the Contractor's responsibility.

**3.31.8** Care shall be taken to prevent damage to valves and other appurtenances during handling and installation. All materials shall be carefully inspected for defects in workmanship and materials:

**3.31.8.1** All debris and foreign material cleaned out of valve openings, etc.;

**3.31.8.2** All operating mechanisms operated to check their proper functioning, and all other nuts and bolts checked for tightness.

**3.31.8.3** Valves and other equipment, which do not operate easily, or are otherwise defective, shall be replaced. All valves shall be carefully incorporated into the water main and supported in their respective positions free from all distortion and strain.

**3.31.8.4** Valves and valve boxes shall be set plumb. Valve boxes, besides being plumb, shall be centered directly over the valves.

**3.31.8.5** All pipes showing cracks shall be rejected. If cracks occur in the pipe, the contractor may, at his own expense and after approval of the Department cut off cracked portions at a point at least twice the pipe diameter from the visible limits of the crack and use the sound portion of the pipe.

**3.31.9** Repairs of any damaged newly installed pipe shall include two solid sleeve couplings, retainer glands, and an appropriate length of pipe of the same material as that which was broken, or Department approved equal.

**3.31.10** Prior to acceptance by the City, the contractor shall replace any new pipe found to be defective at any time, at no expense to the City.

**3.31.11** All water mains shall have no less than six (6) feet of cover unless waived by the Department. Each pipe shall be laid so as to form a close joint with the next adjoining pipe and to bring the inverts continuously to the required grade. In no cases shall the waterline have less than four (4) feet of cover over the top of the pipe. Temporary support, adequate protection, and maintenance of all underground structures, drains, sewers, and other obstructions encountered in the progress of the work shall be provided at all times.

- 3.31.12** At all times, when pipe laying is not actually in progress, the open ends of the pipe shall be closed by temporary watertight plugs or by other approved means. If water is in the trench when work is resumed, the plug shall not be removed until all danger of water entering the pipe has passed. During construction, the contractor shall conduct operations so as to prevent the accumulation of water ice, and snow in the vicinity of excavations or in the vicinity of excavated areas, and to prevent water from interfering with the progress and quality of the work. Under no conditions shall water be allowed to rise in open trenches after pipe has been laid.
- 3.31.13** Accumulated water, ice, and snow shall be promptly removed and disposed of by pumping or other approved means. Disposal shall be carried out in a manner that will not create a hazard to public health, nor cause injury to public or private property, work completed or in progress, or public streets. Disposal shall not cause any interference in the use of streets and roads by the public. Disposal may also require protection of storm drain facilities. Pipes under construction shall not be used for drainage of excavations.
- 3.31.14** Any deflection of pipe joints shall be within the limits specified by the manufacturer.
- 3.31.15** There shall be no physical connection between the distribution system and any pipes, pumps, hydrants, or tanks that are supplied with water that is, or may be, contaminated.
- 3.31.16** As necessary, temporary PVC markers shall be supplied at all gate valves, curb boxes, and at the end of water lines to a minimum of twelve (12) inches above finish grade until accepted by the Department, in non-travelled areas.
- 3.31.17** All surplus material and debris shall be removed as the project progresses, leaving all areas clean and presentable.
- 3.31.18** Unless otherwise required, all paving and sidewalks that may be damaged during construction shall be replaced with the same kind of material that previously existed as required by the City.
- 3.31.19** All areas within the limits of the project shall be loamed and seeded as called for in the project specifications. This shall include areas of new construction, except as the actual area occupied by structures, roads,

parking area and walks, and shall include area of established landscape and flora through which the work may pass where grassed area are affected. Areas to be seeded may have subgrade placed at any time of the year. However, placement and preparation of loam (topsoil) and seeding shall be performed only between the dates of April 20 and October 15, or as approved otherwise by the Department. Eroded areas shall be graded to specific contours prior to loaming or seeding.

**3.31.20** No water lines shall be installed after November 15 or before April 1 without prior approval of the Department. The Department may restrict work before November 15 and after April 1 during adverse weather conditions. The Department may not allow excavating for water mains during the winter months except by special permission.

**3.31.21** See Detail W-17: Tie-In Detail.

## **BACKFILLING**

### **3.32**

**3.32.1** Trenches shall be backfilled to subgrade with, wherever possible, material excavated from the trench, provided the material consists of loam, sand, gravel or other suitable material and shall be done only after approval of the Department. Material for backfilling shall be free of roots, stumps, and frost. Backfill shall not be placed on frozen material. Materials used for backfilling trenches shall be free of stones weighing more than thirty (30) pounds. No stones measuring over three (3) inches in the longest dimension shall be placed within one (1) foot of the pipeline being backfilled. Stones found in the trench shall be removed for a depth of at least six (6) inches below the bottom of the pipe. In general, use of blasted rock, as trench backfill will not be permitted. Any materials excavated from the site not conforming to these Specifications, shall be disposed of and replaced with approve materials by the contractor.

**3.32.2** Backfill material shall be tamped in layers around the pipe to a sufficient height above the pipe to adequately support and protect the pipe. Backfill for pipelines under roadways shall be placed in twelve (12) inch lifts, each lift being compacted to not less than 95% of maximum dry density as determined by the AASHTO-180 Modified Proctor. Pipelines outside of roadways or in cross country routes shall be compacted to 90% maximum density as determined by the AASHTO-180 Modified Proctor. If conditions warrant, the backfilling of trenches may be done with mechanical equipment. Particular precautions shall be taken in the placement and compaction of the backfill material in order not to damage the pipe, pipe coating or structure. The backfill shall be brought up evenly. Around

valve boxes, the backfill shall be tamped to a distance of four (4) feet on all sides of the box, or to the undisturbed trench face, if less than four (4) feet. Backfilling in all public roadways shall be so compacted as to leave no depression in the road. Additional backfill requirements may apply within State Highway Right-Of-Ways. All public road surfaces shall be restored to a condition at least equal to that which existed prior to the start of construction. Precautions shall be taken against undue damage to existing surface materials.

**3.32.3** No compacting shall be done when the material is too wet to be compacted properly. At such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions are taken as may be necessary to obtain proper compaction. Material shall be considered “too wet” if the material is sufficiently above the optimum water content for the material properties to reduce the ability to achieve proper compaction. Additionally, the material shall also be considered “too wet” if the compaction equipment creates a safety hazard to the workers performing the compaction.

**3.32.4** Surplus excavated materials shall be disposed of in a satisfactory manner. Surplus material or spoil shall be removed promptly and disposed of so as not to be objectionable to abutters or the general public.

**3.32.5** Trenches that have been improperly backfilled, enclosed or covered before inspection of fittings and joints shall be reopened and re-backfilled at the contractor’s expense.

3.33

### **WATER/SEWER SEPARATION**

**3.33.1** Water mains crossing sewers shall be laid to provide a minimum vertical distance of eighteen (18) inches between the outside of the water main and the outside of the sewer line. This shall be the case where the water main is either above or below the sewer. At crossings, one full length of pipe shall be located so both joints will be as far from the sewer as possible. This vertical separation shall be maintained for that portion of the water main located within ten (10) feet horizontally of any sewer it crosses. Water mains must be laid at least five (5) feet horizontally from any existing or proposed storm sewer and ten (10) feet from any existing or proposed sanitary sewer.

**3.33.2** When it is impossible to obtain horizontal and vertical separation on new installations, both the water main and sewer main shall be constructed

of Department approved waterworks material with watertight joints that may include properly sized manhole boots, and shall be pressure tested before backfilling. A PVC sleeve may be required for one or both mains in addition to the waterworks material. Lines may also be encased in concrete as required by the Department. No water main shall pass through or come in contact with any part of a sewer manhole.

**3.33.3** Distribution lines shall not be placed closer than fifty (50) feet horizontal distance from any septic tank or leach field unless approved by the VT Water Supply Rule Provisions under Chapter 21.8.6.4 or the Department.

**3.33.4** Force main crossings shall be arranged so that at least one full length of sewer pipe is centered above or below the water line, with the sewer joints as far as possible from the water joints. The new force main line shall be constructed to water main standards for a minimum of twenty (20) feet on either side of the crossing. The section constructed to water main standards shall be pressure tested to maintain 50 psi for fifteen (15) minutes without leakage prior to backfilling. In those areas that proper cover cannot be provided, proper insulation shall be installed.

**3.33.5** Separation between storm drain pipes, sanitary sewer pipes and water pipes shall be in accordance with the Vermont Water Supply Rule. Where the minimum separation distances cannot be met, and the VT WSR is silent, these specifications shall prevail.

**3.33.6** See Detail W-18: Water Under Sewer Line Crossing Detail, and Detail W-19: Water/Sewer Line Crossing Detail.

### 3.34

#### **STEEL SLEEVE, JACK, AND BORE**

**3.34.1** Before beginning operations related to excavation by jacking, the Contractor shall submit to the Department a detailed, written description of the equipment and methods he /she proposes to use and acceptable sketches showing details of the jacking pit, head, frame, reaction blocks, and arrangement of the jacks. The contractor shall not proceed with work until authorized by the Department. All requests to construct new water lines across existing municipal streets shall be reviewed and approved by the Department before proceeding.

**3.34.2** All work to construct highway crossings as indicated on drawings shall be performed by a contractor with at least three years experience in jacking. Three (3) weeks prior to start of work, the contractor shall furnish the Department a Statement of Experience and Welding Certification for such work from those doing the jacking.

**3.34.3** The wall thickness of the steel casing pipe shall be three-eighths ( $\frac{3}{8}$ ) inches as indicated on the drawings and steel plate for steel casing pipe shall conform to ASTM A36. The steel plate shall be rolled and welded to the diameter size as indicated on drawings. Welding shall be done by approved standard welding practice. When more than one section of casing is to be used, the ends of the section to be joined shall be welded in accordance with approved standard welding practices for the use intended.

**3.34.4** Services up to two (2) inches may use PVC pipe for a sleeve with approval of the Department. PVC sleeves shall be Schedule 80.

**3.34.5** All carrier pipes larger than two (2) inches shall be ductile iron as shown in drawings.

**3.34.6** See Detail W-20: Steel Sleeve Encasement Joint Weld Detail, and Detail W-21: Steel Sleeve Encasement Detail.

### **3.35 EXECUTION OF SLEEVE JACK AND BORE**

**3.35.1** The jacking pit shall be of adequate size to accommodate the sheeting, shoring or trench box, Jacking head, frame, jacks, reaction blocks, added section of pipe, and other material and equipment, and to provide sufficient working space. The pit shall be excavated by suitable methods as specified for normal excavations and shall be kept free of water.

**3.35.2** Sleeves shall be at the same elevation as the water main.

**3.35.3** The jacking head shall be of suitable bearing pieces to protect the pipe from damage due to the thrust from the jack to the pipe, and to transfer that thrust from the jack to the pipe.

**3.35.4** The jacking frame, upon which the pipe being jacked will rest, shall be on railroad rails or suitable steel or wooden members set to correct line and grade to act as guides for the true alignment of the pipe.

**3.35.5** The jacks shall be of ample capacity to provide more than the anticipated jacking capacity needed.

**3.35.6** The reaction blocks shall be suitable to provide resistance to, and distribution of, the reaction from the jacks.

- 3.35.7** It is extremely important that the jacking apparatus be strongly constructed, set, and maintained in proper relative position and alignment in order to minimize forces that would tend to bend the pipe, cause it to deflect from true alignment, or displace the reaction blocks.
- 3.35.8** Joints of steel casing pipe shall be welded before being subjected to the jacking operation.
- 3.35.9** All welds shall conform to the AWWA Standard for Field Welding of Steel Water Pipe Joints, Designation C206.
- 3.35.10** In excavation from within the jacking pipe, extreme care shall be used to avoid the loss of material from outside the limits of the pipe in the final position. Excavation shall be carried ahead of the pipe only to the extent possible without the loss of material. Should material, either earth or rock, be lost outside the limits of the pipe in its final position, pressure grout shall be applied outside the casing with such equipment as may be directed.
- 3.35.11** Should rock or boulders be encountered after jacking has commenced and blasting is necessary, blasting shall be done only after required permits have been approved and then in such a manner that neither the jacked casing nor the road above the blast will be damaged. The size of the blast and the procedures for blasting shall be acceptable to the Department.
- 3.35.12** Once jacking has started, it shall be a continuous operation until completion of the jacking operation in order to reduce the possibility of a so-called “stuck” pipe, even though this may involve working outside the normal workday.
- 3.35.13** Care shall be taken during excavation and jacking operations to ensure that the jacked pipe remains true to line and grade. Maximum deviation from line and grade shall be one-half ( $\frac{1}{2}$ ) inch per one hundred (100) feet for carrier pipe and casing pipe. Guided boring equipment utilizing a pilot tube for steering to the target with an LED illuminated target within the tube should be utilized to ensure the accuracy of the jacking process. Steel sleeve jacking and boring shall be performed in such a manner so as to avoid any bends or extra fittings on the water main.
- 3.35.14** During jacking operations, voids shall be prevented outside of the sleeve being jacked. If they occur they shall be filled with a lean grout to the satisfaction of the Department.
-

**3.35.15** The carrier pipe shall be installed in the sleeve, using stainless steel casing spacers described herein, two (2) per each section of pipe. Pipe shall be Tyton Joint or approved flexible restrained joint pipe.

**3.35.16** Following installation, the carrier pipe shall be tested for leakage in accordance with testing procedures outlined in the Testing and Disinfecting section.

**3.35.17** The ends of the sleeve shall be plugged using hydraulic cement or concrete or otherwise sealed to retain the annular fill, if such annular fill is used, and to prevent flow of surrounding soils into the sleeve.

**3.35.18** See Detail W-20: Steel Sleeve Encasement Joint Weld Detail, and Detail W-21: Steel Sleeve Encasement Detail.

### **CASING SPACERS**

#### **3.36**

**3.36.1** Casing spacers shall be bolt on style with a two-piece shell made from T-304 stainless steel of a minimum 14-gauge thickness. Each shell section shall have bolt flanges and/or a hinged side; bolt flanges shall be formed with ribs for added strength. Connecting flange shall have a minimum of three 5/16" T-304 bolts. The shell shall be lined with ribbed PVC extrusion with a retaining section that overlaps the edge of the shell and prevents slippage. Bearing surfaces (runners) made from UHMW polymer with a static coefficient of friction of 0.11-0.13 shall be attached to support structures (risers) at appropriate positions to properly support the carrier within the casing and to ease installation. The runners shall be attached mechanically by T-304 threaded fasteners that are inserted through the punched riser section and TIG welded for strength. Risers shall be made of T-304 stainless steel of a minimum 10 gauge. All risers over six (6) inches in height shall be reinforced. Risers shall be MIG welded to the shell. All metal surfaces shall be fully chemically passivated.

**3.36.2** Casing spacers shall be model CCS as manufactured by Cascade Waterworks Mfg. Co. or prior approved equal.

**3.36.3** Annular space may remain void as directed by the Department when casing spacers fit tightly within the casing. However, sleeve ends shall be plugged using hydraulic cement or concrete.

**3.36.4** See Detail W-22: Steel Sleeve Casing Spacer Detail.

**EROSION CONTROL**

**3.37**      **3.37.1** The Contractor shall construct and maintain all erosion control measures in accordance with Department specifications, or in the case of no specifications then erosion control measures shall conform to the "Vermont Handbook for Soil Erosion and Sediment Control on Construction Sites", current edition.

**3.37.2** Dust shall be controlled through the application of calcium chloride or water, as required by the Department.

**TESTING AND DISINFECTION**

**3.38**      **3.38.1** All water mains shall be constructed, tested and disinfected in accordance with AWWA Standards C-600, C-605, C-651 and The Vermont Water Supply Rule. Minimum testing pressure shall be 1.5 times the working pressure of the installed line or 200 psi, whichever is greater, and will be monitored at the lowest elevation in the length of the pipeline being tested. The longest length of test pipe shall be 1,000 feet unless waived by the Department. Pressure tests shall be up to each curb stop with corporations fully open.

**3.38.2** No hose or fire hydrant shall be used in collection of water samples. A corporation stop shall be installed in the main with a copper gooseneck assembly for testing. After testing is completed and samples have been collected, the corporation on the test line shall be shut off and the gooseneck assembly disconnected and removed.

**3.38.3** All water flushed during charging and sampling of the new water main shall be de-chlorinated.

**3.38.4** Maximum allowable leakage will be

$$L = SD\sqrt{P}$$

148,000 as outlined in AWWA Standards

Where:

L = allowable leakage, in gallons per  
hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge)

a) Testing: All tests shall be conducted by and at the expense of the Contractor. The Engineer will give direction pertaining to the test methods and observe the field-testing.

b) Hydrostatic Test of Pipeline: The pipeline, including hydrant laterals, shall be tested in accordance with AWWA Standard C-600 Section 4.

c) Disinfection: Disinfection of the pipeline shall be directed by the Engineer and at the Contractor's expense. AWWA Standard C-651 shall be used as a basis for the disinfection process.

**3.38.5** The Engineer or Department will require as minimum:

**3.38.5.1** Complete flushing of the pipeline to wash out all dirt, debris, etc. which may have accumulated in the pipeline during construction. A reducing agent (dechlorinating agent) shall be used at the point of flushing to eliminate the free chlorine residual per the direction of the Department.

**3.38.5.2** Following flushing to clean clear water, the Contractor will add chlorine to the entire pipeline volume of water such that the water will have not less than 25 mg/L free chlorine, and let the mixture set for at least 24 hours.

**3.38.5.3** After the 24-hour duration, the water in the pipeline shall be tested for residual free chlorine and must contain a minimum of 10 mg/L chlorine. If less than 10 mg/L is found, then the disinfection procedure shall be repeated until at least 10 mg/L chlorine residual is indicated by test.

**3.38.5.4** Upon successful completion of step 39.05.3 above, the pipeline shall be flushed again until the chlorine concentration in the

pipeline is no higher than that prevailing in the supply system. A reducing agent (dechlorinating agent) shall be used to eliminate the free chlorine residual in the flushing process per the direction Department.

**3.38.5.5** After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main, and submitted to the Vermont Health Department for analysis. At least one set of samples shall be collected from every 1,000 feet of the new water main, plus one set from the end of the line and at least one set from each branch. All samples shall show the absence of coliform organisms and if required, the presence of a chlorine residual. (AWWA C651) If the initial disinfection fails to produce samples, which pass the V.S.H.D. requirements for potable drinking water, then the new main shall be re-flushed and shall be resampled until satisfactory test results are obtained. All sample reports must be submitted to the Department prior to opening any connection to an existing water line.

**3.38.5.6** Upon satisfactory results by the Vermont State Health Department, the pipeline may be placed in service. All costs for water, materials, equipment and labor to perform the required testing disinfection, and flushing of the pipeline shall be paid by the Contractor.

**3.39**

### **SUBMITTAL OF TEST RESULTS**

**3.39.1** The Applicant or Project Engineer shall be responsible for submittal of test results to the Department. The Applicant or Project Engineer shall also provide a letter to the Department certifying that the water system has passed all tests, is constructed in accordance with the approved plans, except as may have been modified by approved change order, and is in condition to be placed in service. Submittal of all tests results shall be required prior to the water main being placed into service.

**3.40**

### **FINAL INSPECTION**

**3.40.1** For one year from the date of final project completion, the applicant, developer/contractor will be responsible for any necessary repairs or corrections as part of the project warranty. Repairs made during the warranty period will carry a minimum warranty of one year from the time

the repair was completed. At the end of the warranty period, and after Record Drawings have been submitted, an inspection will be performed by the Department of all lines and appurtenances. The Contractor shall correct any punch list items accumulated during the inspections after receipt of this list. Incomplete work on the water system shall not be included in the initial final inspection, but shall be inspected as the project continues. The Contractor shall repair, replace, or retest promptly as directed by the Department, and without further charges, all work, equipment, materials or parts, which may fail during the warranty period.

**3.40.2** A final walk through inspection shall be conducted by the Department prior to the water system being accepted for ownership by the City. This inspection shall include but not be limited to:

**3.40.2.1** Valves, hydrants, and curb stops operating properly.

**3.40.2.2** Valve boxes and covers set plumb and at proper elevations.

**3.40.2.3** Proper hydrant nozzle height above grade.

**3.40.2.4** Proper hydrant opening direction, nozzle thread, operating nut size, Storz connection, and barrel color.

**3.40.2.5** Proper distance from the face of the curb of hydrant nozzles.

**3.40.2.6** Hydrant flags meeting these Specifications installed on each fire hydrant at the time of hydrant installation.

**3.40.2.7** Curb boxes inside ROW, set to grade, containing stainless steel operating rod, and plumb.

**3.40.2.8** Tie information and Record Drawings complete and submitted.

**3.40.2.9** Material testing results, lab reports, manufacturer's certificates, and leakage test results complete and on file.

**3.40.2.10** General appearance and restoration.

**3.40.2.11** Submittal of O&M manuals in hardcopy and Adobe Acrobat Reader (.pdf) format.

**3.40.2.12** Submittal of accurate Record Drawings in hardcopy format and Auto-CAD Version 2003 format (.DWG) or newer. Generally, Record Drawings shall include:

**3.40.2.12.1** Accurate measurements of all water lines,

**3.40.2.12.2** Measurement to within one-half (1/2) foot to all valves and curb stops from permanent fixtures such as telephone poles, fire hydrants, buildings, transformers, etc.

**3.40.2.12.3** Accurate depths of all water lines,

**3.40.2.12.4** Locations of all other buried utilities and structures.

## CONTACTS

3.41

### CITY OF WINOOSKI PUBLIC WORKS CONTACTS

Department of Public Works	655-6410
Champlain Water District	864-7454
DIG SAFE	811

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## **SPECIFICATIONS AND DETAILS FOR THE INSTALLATION OF WATER LINES AND APPURTENANCES IN THE CITY OF WINOOSKI**

### **MATERIAL REFERENCE GUIDE**

#### **PIPE – Sections 3.5 & 3.6**

Ductile Iron: Class 52, cement lined. 4" & 6" DI pipe: two (2) brass wedges per joint. >8" DI pipe: three (3) brass wedges per joint.

PVC/C-900: DR 14, Class 200, installed with an approved tracing wire accessible in a Buffalo Box or approved equal. The wire shall be placed in a one (1) inch PVC conduit under roadway and sidewalk crossings. Tracing wire shall be a blue coated, solid tracer wire, 12 gauge minimum, and run continuously for the full length of the pipe line, surfacing only in approved access boxes. If splicing is necessary, a direct bury splice kit is required.

#### **FITTINGS – Section 3.8**

Ductile Iron fittings shall conform to ANSI/AWWA C110/A21.10, 350 pounds working pressure. DI fittings larger than twelve (12) inches shall have a standard body length. DI fittings shall be rated for 250 psi. However twelve (12) inches and smaller shall be rated for 350 psi. All DI compact fittings shall conform to AWWA/ANSI C153/A21.53 standards.

Anchor tees (aka: Swivel tees, Hydrant tees) shall be class 350 DI, cement lined, conforming to ANSI/AWWA C110/A21.10, C111/A21.11, and C104/A21.4. In lieu of anchor tees, mechanical joint tees may be used with Foster Adapters to secure the valve directly to the branch tee, with Department approval. Mechanical joint tees shall conform to the above referenced standards.

All fittings shall be restrained, wrapped in plastic, and have concrete thrust blocks poured in place per the City Water Specifications.

Mechanical joint restraints shall be EBAA or Sigma, or Department approved equal.

**TAPPING SLEEVES AND VALVES – Section 3.9**

Tapping sleeves: Stainless Steel, Powerseal Model 3490MJ.

Tapping valves: DI, epoxy coated, stainless steel bolts, open left, MJ, stainless steel valve extension for valves greater than six (6) feet deep. Mueller, Kennedy, or Department approved equal. Any part of any service line valve in contact with potable water shall comply with Vermont's lead in Consumer Products Law, Act 193 and/or Federal requirements, whichever is greater.

**GATE VALVES - Section 3.10**

DI, epoxy coated, stainless steel bolts, open left, MJ, stainless steel valve extension for valves greater than six (6) feet deep. Mueller, Kennedy, or Department approved equal. Any part of any service line valve in contact with potable water shall comply with Vermont's lead in Consumer Products Law, Act 193 and/or Federal requirements, whichever is greater.

**FIRE HYDRANTS – Section 3.12**

Main Valve Opening: 5¼ inches, Nozzle Arrangement: Two 2½-inch Hose Nozzles with National Standard Thread (NST), Pumper Nozzle with five (5) inch Storz Connection, Inlet Connection: 6-inch Mechanical Joint, "Mega-Lug" or equivalent retaining gland, and concrete thrust block, Operating Nut: Standard 1½ inch Pentagon, Direction of Opening: Counterclockwise, Depth of Bury: Six-foot cover. The hydrant shall have at least fifteen (15) inches and no more than twenty-one (21) inches between the bottom of the pumper nozzle cap and the ground, Drain: The hydrant shall be non-draining or have the drains permanently plugged, Color: Red enamel, hose and pumper nozzles shall be quarter-turn type secured by stainless steel or corrosion resistant pins or screws. Pressure seals behind nozzle flanges shall be "O" rings. A breakable coupling retained in place by stainless steel or corrosion resistant pins shall make the union between the upper and lower stems. The two-piece traffic flange shall be held in place by nuts and bolts. The upper barrel shall be able to rotate 360 degrees without removing any bolts. Approved hydrant flags shall be required and placed on each new hydrant at the time of installation. Hydrant assemblies shall consist of an anchor tee or Swivel Joint Hydrant Tee., a six (6) inch mechanical joint gate valve conforming to the above specifications, the appropriate length of six (6) inch Ductile Iron Cement Lined, Class 52 pipe, secured to the gate valve and hydrant

with approved retainer glands, the fire hydrant and appropriate thrust block. Hydrants shall be Kennedy K81-D or Mueller Super Centurion 250.

### **CORPORATIONS & CURB STOPS – Section 3.15**

Service lines shall be copper from the corporation to the curb stop, and from the curb stop to the building, for water services up to and including two(2) inch. Copper tubing shall be type “K”, soft temper, conforming to ASTM B88. The name or trademark of the manufacturer and type shall be stamped at regular intervals along the pipe.

All underground service line valves, fittings, corporations, curb stops, meter tail pieces, elbows, and angle valves shall be manufactured in accordance with AWWA C-800, latest edition. Any part of any service line valve, fitting, corporation, curbstop, meter tail piece, elbow, and angle valve in contact with potable water shall comply with Vermont’s Lead in Consumer Products Law, Act 193 and/or Federal requirements, whichever is greater. No-lead brass fittings shall be Cambridge Brass No-Lead, or Department approved equal. All no-lead brass fittings shall have the manufacturers name or trademark integrally stamped or cast on it. Another marking identifying the “no-lead” brass alloy shall also be cast or stamped on the fitting.

Corporations shall have threads per AWWA C-800 Table 7/Figure 2 at the inlet, and a compression type fitting at the outlet. Both inlet and outlet shall be the same in size. Corporations shall be Cambridge Brass or Department approved equal. Corporations shall be ball valve type with minimum allowable pressure rating of 200 psi.

Service saddles shall be Teflon or Epoxy coated with stainless steel strap(s), bolts, nuts, and mechanism for attaching to the pipe barrel. Service saddles must meet manufacturer’s guidelines and recommendations for specific pipe materials.

Curb stops shall be a ball valve type, minimum allowable pressure rating of 200 psi, manufactured in accordance with AWWA C800, open left, have a positive stop, be full port, provide a drip tight shutoff in the closed position, be of the tee design or flat design. Both the inlet and outlet of the curb stop shall have compression type fittings. The tee head of the curb stop shall have the provision for the connection of a service rod. Curb stops shall be Cambridge Brass No-Lead, or Department approved equal.

Curb boxes shall be of sliding adjustable Erie style capable of adjusting from five (5) feet to six (6) feet. The base of the box shall be arch type so as to prevent the box from resting on the curb stop. The adjustable upper section shall be one (1) inch diameter. Stationary rods affixed to the key of the curb stop with a brass pin shall be thirty (30) inches in length for ¾" and 1" curb stops and twenty-four (24) inches for large curb stops. Curb box rods shall be stainless steel. The word "WATER" shall be inscribed on the cover of the box. The cover of the box shall have countersunk brass pentagon plug for paved or concrete areas, and standard two holes for grass areas.

**PIPE INSULATION – Section 3.19**

Four (4) inch high density polystyrene sheets.

**POLYETHYLENE PIPE ENCASEMENT – Section 3.20**

Four (4) mil sleeved with appropriate adhesive tape.

**CHECK VALVES – Section 3.21**

American Flow Control Series 2100 or Department approved equal, DI, epoxy coated body, rated to 250 psi, 100% unobstructed flow area free of pockets, optional flushing actuator, DI disc encapsulated with Burna N rubber, stainless steel hardware.

**AIR RELEASE VALVES –Section 3.22**

Stainless steel float and stainless steel or bronze trim. A brass ball valve in the connecting pipe ahead of the valve. Valves shall be A.R.I D-040, APCO No. 200A or Department approved equal. Orifice shall be three-sixteenth (3/16) inches and valve, isolating valve and connection piping shall be one (1) inch unless specified otherwise. Interconnecting piping shall have pipe and fittings of sufficient size to prevent clogging and entrapment of foreign materials.

**PRESSURE REDUCING VALVES – Section 3.23**

PRV's shall be Ross Valve 40 WR Pilot Operated Pressure Reducing Valve with strainer.

**MANHOLES AND VAULTS – Section 3.24**

Shall conform to ASTM Designation C478 with wall thickness of not less than five (5) inches. Sections shall have tongue and groove joints with butyl mastic rope installed between sections. The exterior of all sections shall have a Bituminous coating.

Drainage from the manhole shall be designed to run to daylight whenever possible. Top sections shall be eccentric except that the concentric flat top sections shall be used where shallow cover requires a top section less than three (3) feet deep. Precast bases, cast-in-place bases, or precast bases integral with base sections may be used. Precast bases and cast-in-place bases shall be eight (8) inches thick. Cement shall be Type II Portland Cement, conforming to ASTM Designation C150. Ladder rungs be aluminum alloy 6061-T6 in accordance with ASTM designation B221, by Aluminum Company of America or Washington Aluminum Company or equal, conforming to Washington Aluminum Company Model T-14-OR. Rungs shall be set in precast sections during casting of section or grouted with a non-shrink grout. Plastic coated steel ladder rungs secured in the walls of the precast structure shall also be acceptable. Rungs shall be aligned so as to allow access from the top of the manhole to the base in a vertical line. Precast concrete manhole manufacturer shall incorporate flexible manhole sleeves within the construction of the manhole in such size to accommodate the size pipe being used.

#### **MANHOLE FRAME AND LID - Section 3.25**

Frame and lid shall be one of the following as approved by the Department:

Standard frame and lid: Non-rocking design with solid lid, Neenah No. R-1077 or equal.

Frost proof: Frost proof frame with solid top and inner lid, machined horizontal bearing surfaces, Neenah R-1758 or equal.

Waterproof frames- bolted lids: Waterproof frames shall have a solid lid with machined bearing surfaces, and sealed with a rubber gasket. Lid shall fasten securely to the frame with countersunk bronze hexagonal-head cap screws. Frame shall be supplied with anchor bolts and bolt holes. Manhole frame and lid shall be Neenah No. R-1915-F (Type L) or equal.

Hinged frame and cover: Hinged frames and covers shall incorporate a blocking feature to prevent accidental closure. The cover must be removable if required. Hinged frames and covers may be used in off road locations, or in traveled ways with approval of the Department. Hinged frames and covers shall be Pamrex, Bilco, or approved equal.

Where no traffic is possible or anticipated, water structures may be accessed via an aluminum hatch by Bilco, or Department approved equal. Aluminum hatches shall

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be rated for 300 psf minimum and have a minimum clear opening of thirty (30) inches. Aluminum hatches shall have a diamond plate skid pattern on them to provide traction, a locking mechanism to hold the hatch open, and be lockable for security purposes.

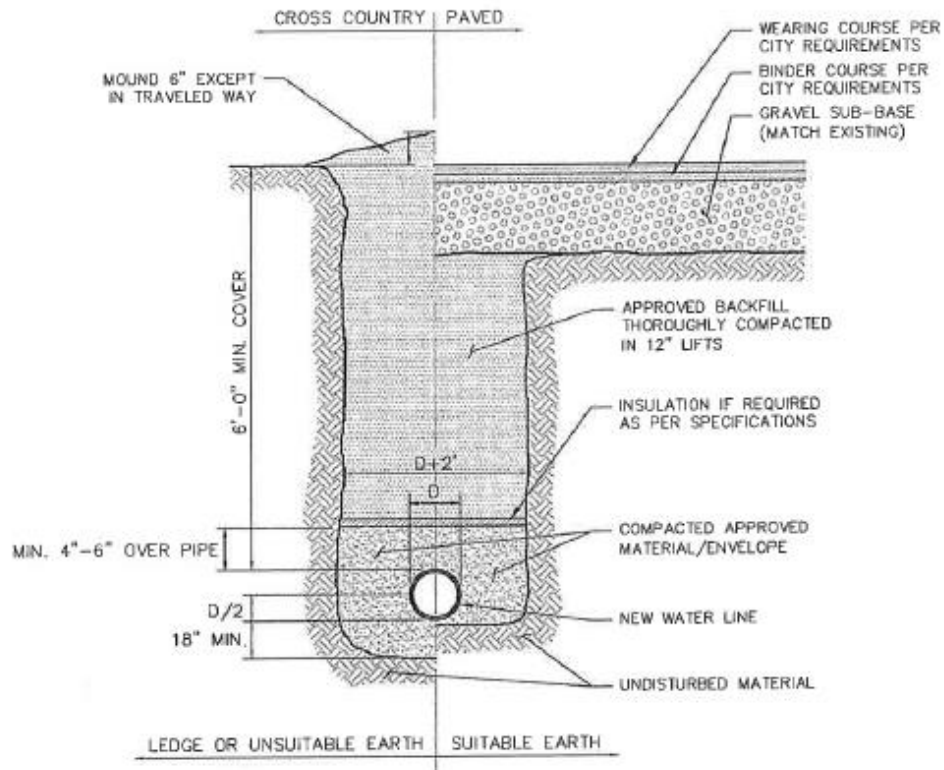
Manhole lids for manholes on buried water mains shall have the word "WATER" cast into the top surface.

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<b>Typical Fire Service Connection Detail .....</b>	<b>W-8</b>
<b>Check Valve Vault Plan View Detail .....</b>	<b>W-9</b>
<b>Check Valve Vault Profile View Detail .....</b>	<b>W-10</b>
<b>Air Release Valves and Manhole Detail .....</b>	<b>W-11</b>
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<b>Tie-In Detail .....</b>	<b>W-17</b>
<b>Water under Sewer Line Crossing Detail .....</b>	<b>W-18</b>
<b>Water/Sewer Line Crossing Detail .....</b>	<b>W-19</b>
<b>Steel Sleeve Encasement Joint Weld Detail .....</b>	<b>W-20</b>
<b>Steel Sleeve Encasement Detail .....</b>	<b>W-21</b>
<b>Steel Sleeve Casing Spacer Detail .....</b>	<b>W-22</b>
<b>Typical End of Line Pipe Anchor Detail .....</b>	<b>W-23</b>
<b>Typical Tie-In to Existing Water Main or Larger Diameter Service Detail .....</b>	<b>W-24</b>
<b>Concrete Encasement Detail .....</b>	<b>W-25</b>



## NOTES:

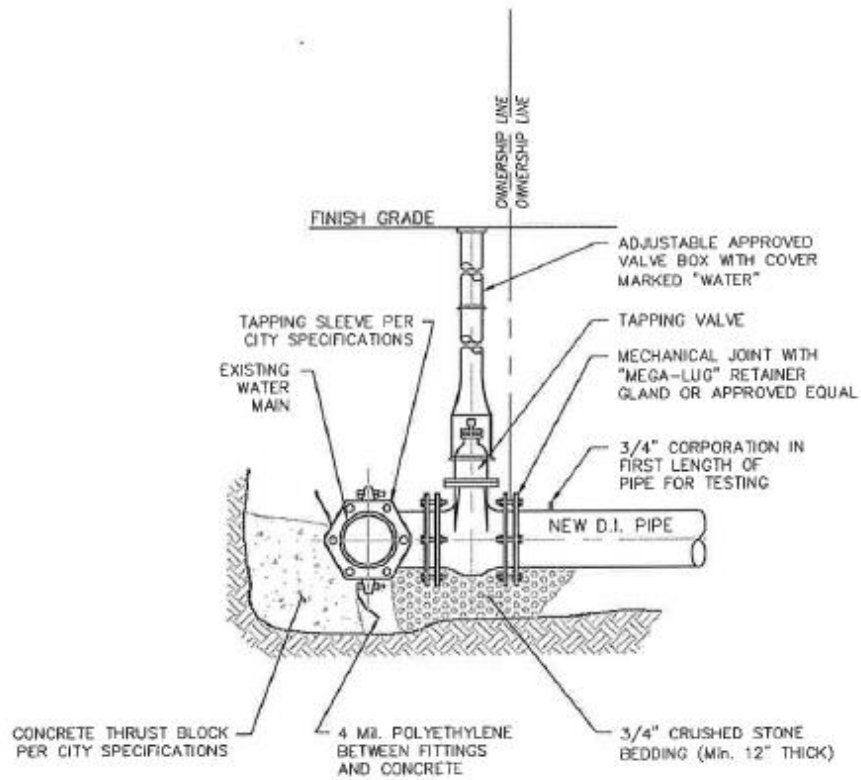
1. Compaction of backfill and bedding shall be a minimum of 90% (95% under roadway surfaces) of maximum dry density determined in the standard proctor test (ASTM D698).
2. All trenches shall meet VOSHA standards prior to any personnel entering a trench.
3. See Specification Section 7 (DI and PVC Water Main Installation) for further requirements.

**TYPICAL WATER TRENCH DETAIL**

N.T.S.



DATE 3/9/2012
DRAWING NUMBER W-1



## NOTES:

1. Wet taps shall be performed by pre-approved firms only.
2. All fittings that are to have concrete poured around them are to be wrapped with 4 mil. polyethylene prior to concrete placement.
3. See Specification Section 9 (Tapping Sleeves and Tapping Valves) and Section 10 (Gate Valves – Resilient Seat) for further requirements.
4. Ownership lines are defined in the City's Water Use Ordinance.

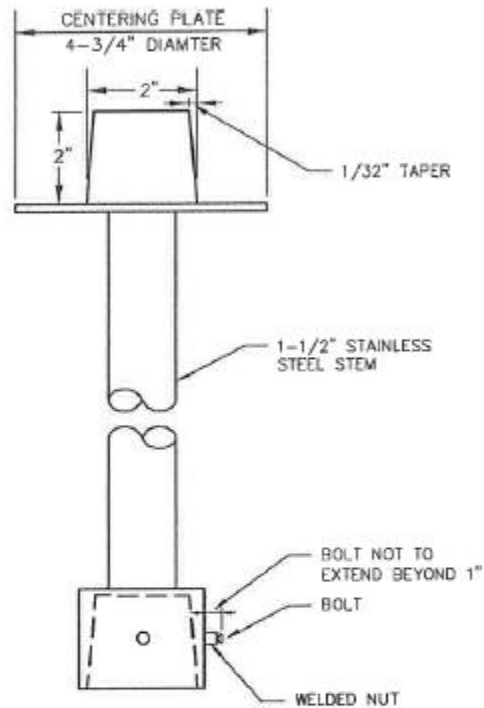
TAPPING SLEEVE & VALVE DETAIL

N.T.S.

DATE  
3/9/2012

DRAWING NUMBER

W-2



## NOTES:

1. Length to be determined at time of installation of gate valve.
2. See Specification Section 10 (Gate Valves – Resilient Seat) for further requirements.

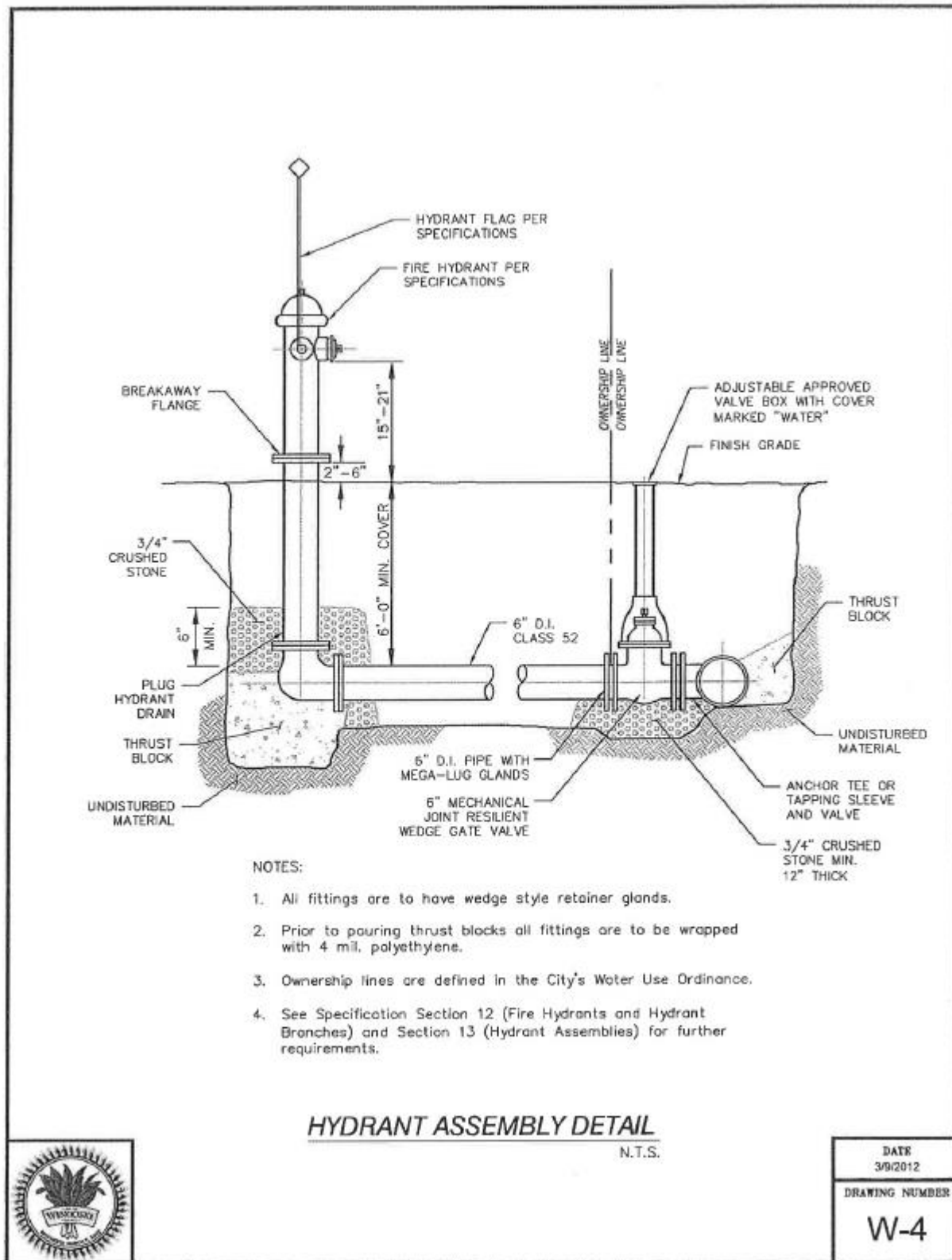
**STAINLESS STEEL VALVE STEM EXTENSION DETAIL**

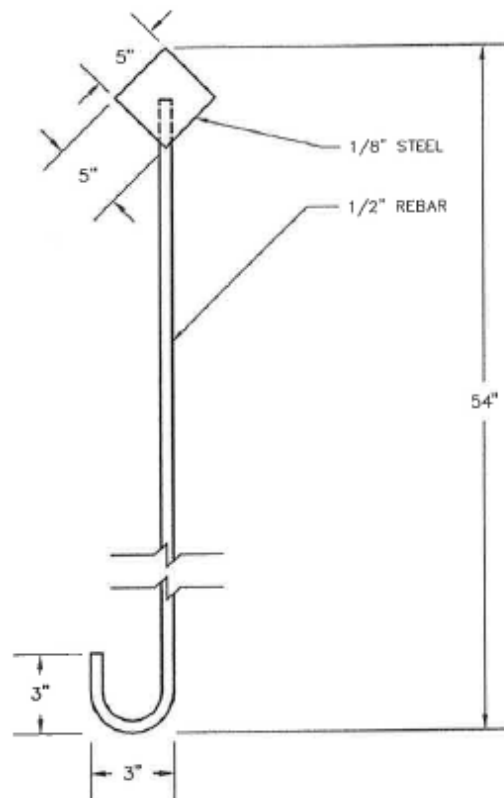
N.T.S.

DATE  
3/9/2012

DRAWING NUMBER

W-3





## NOTES:

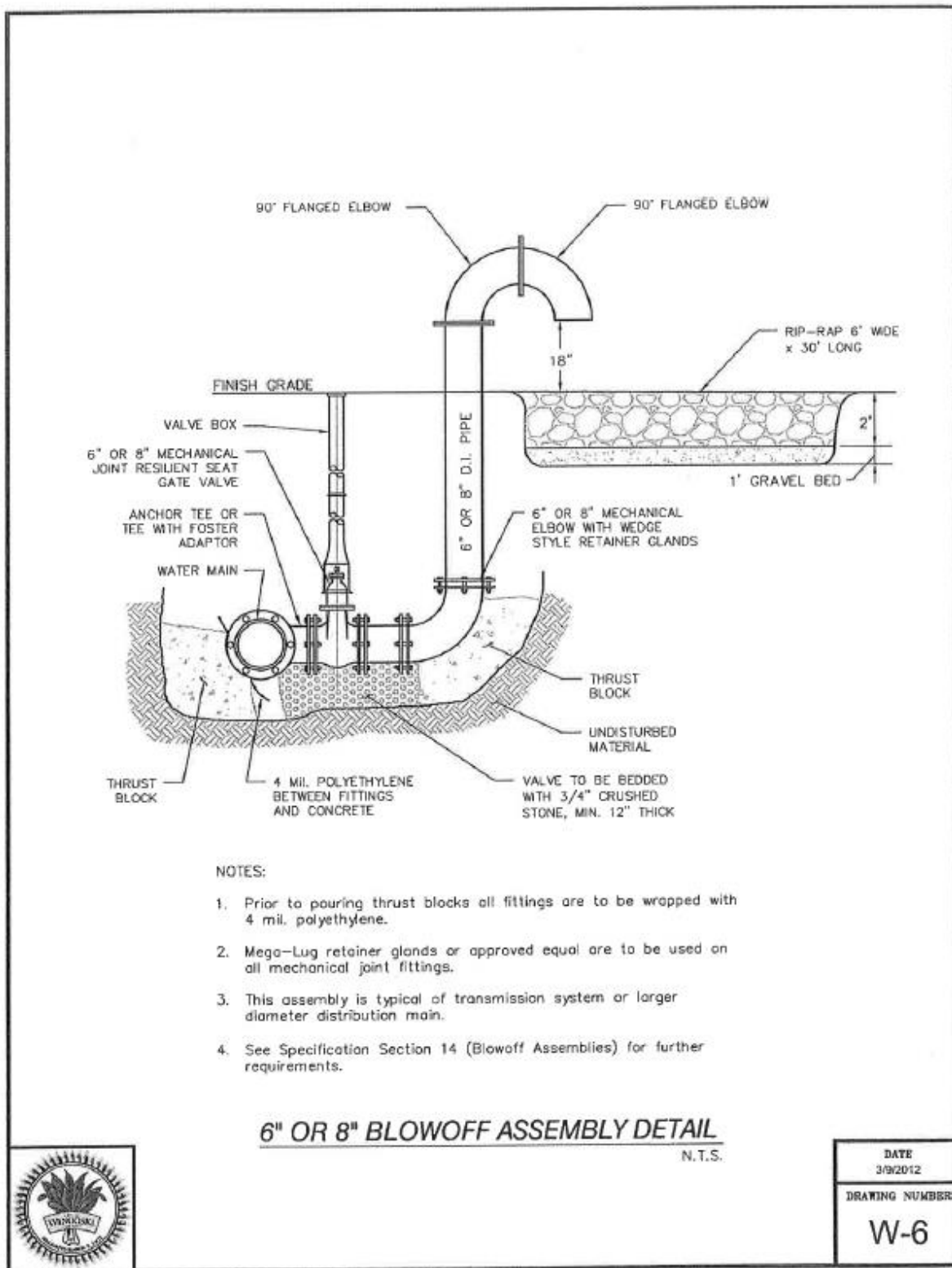
1. Hydrant flags to be painted red.
2. See Specification Section 12 (Fire Hydrants and Hydrant Branches) for further requirements.

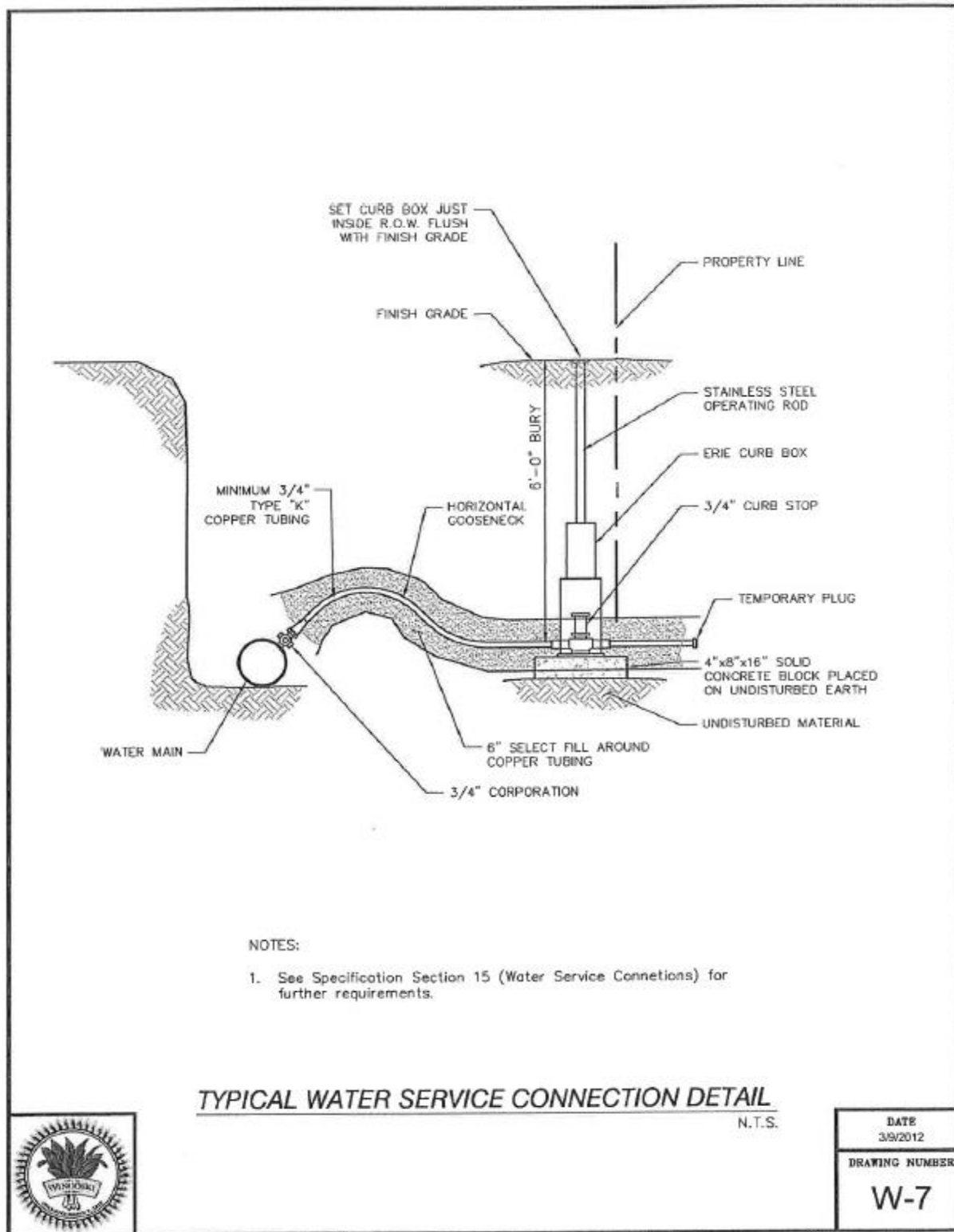
HYDRANT FLAG DETAIL

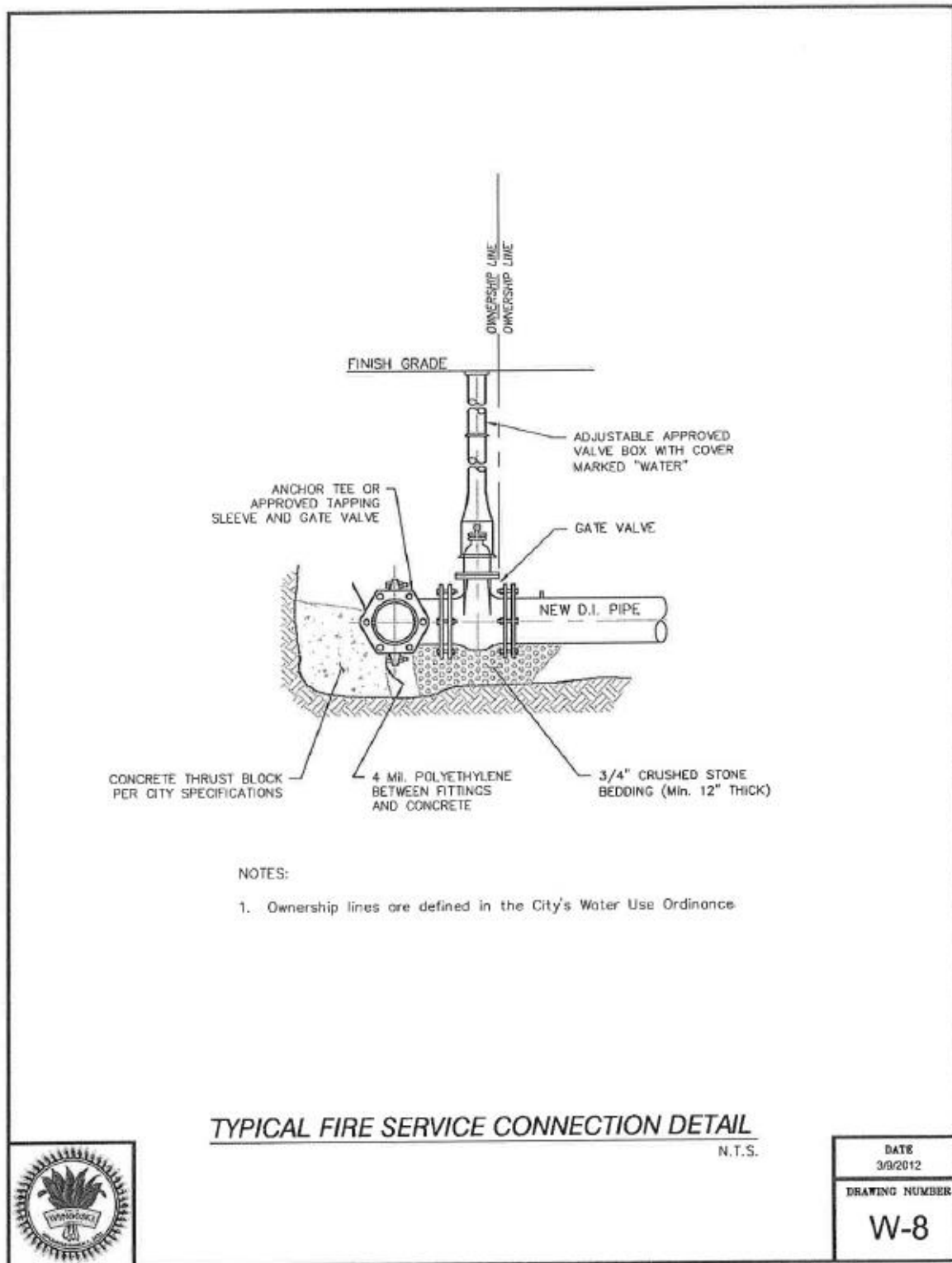
N.T.S.

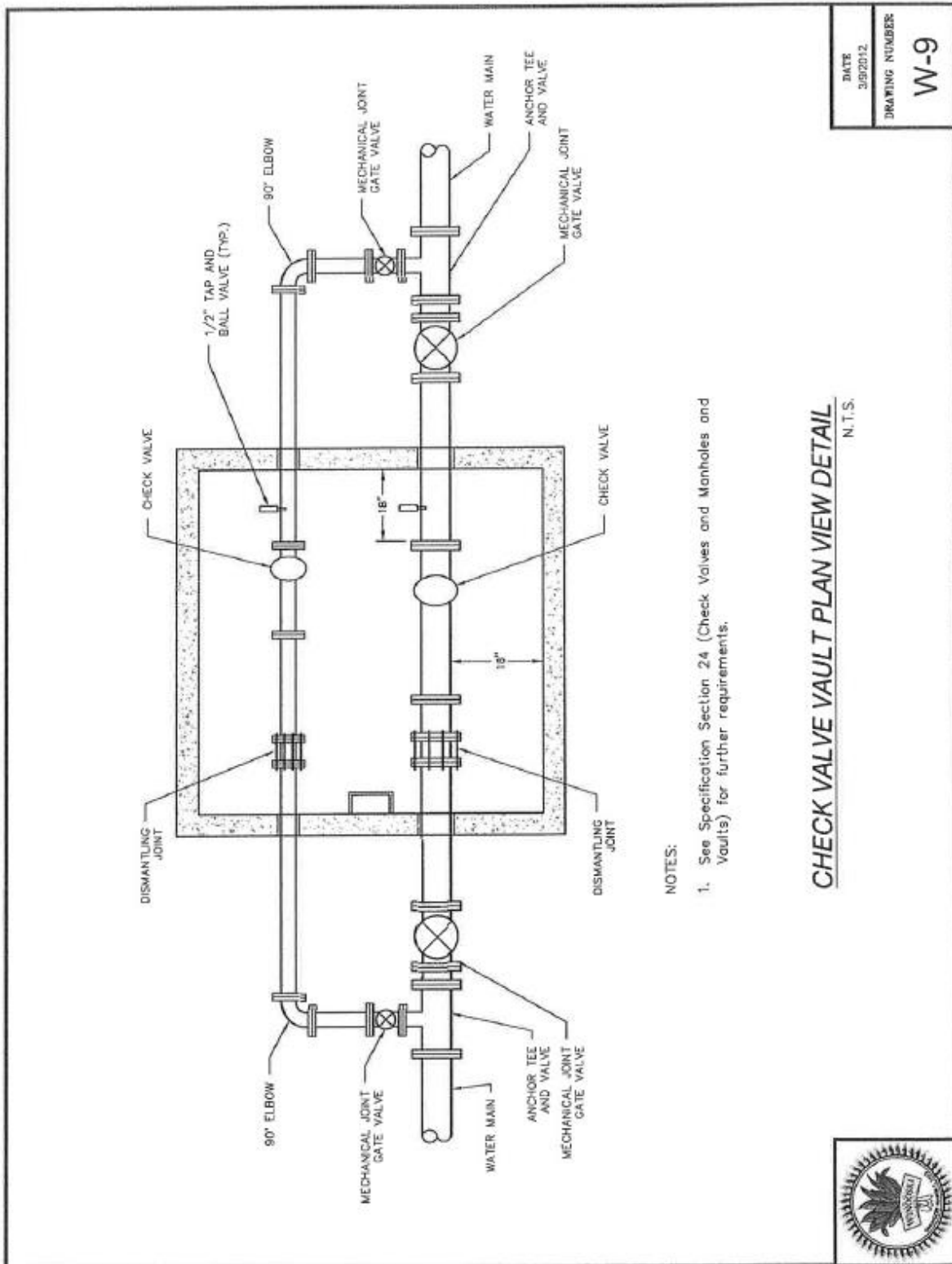


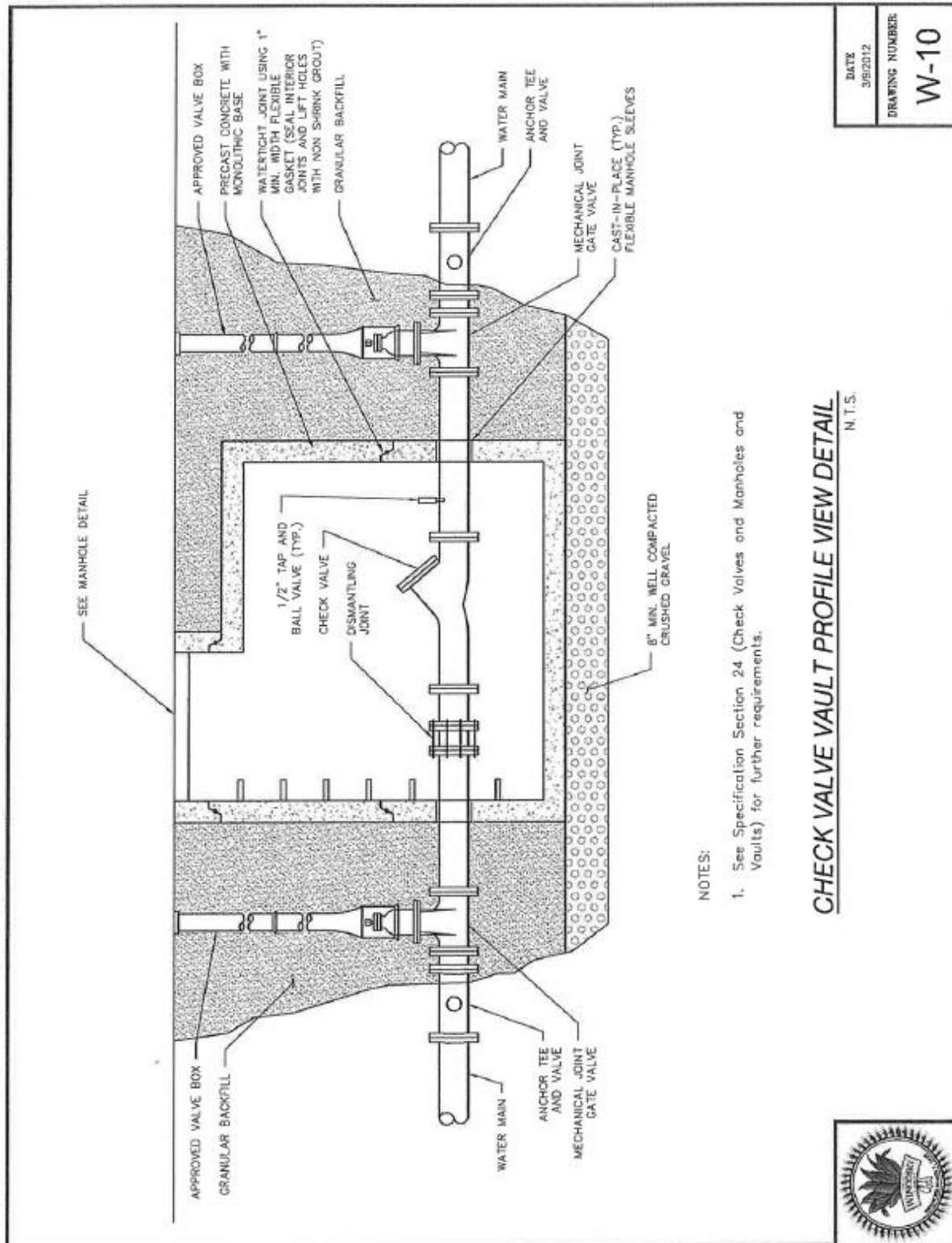
DATE
3/9/2012
DRAWING NUMBER
W-5

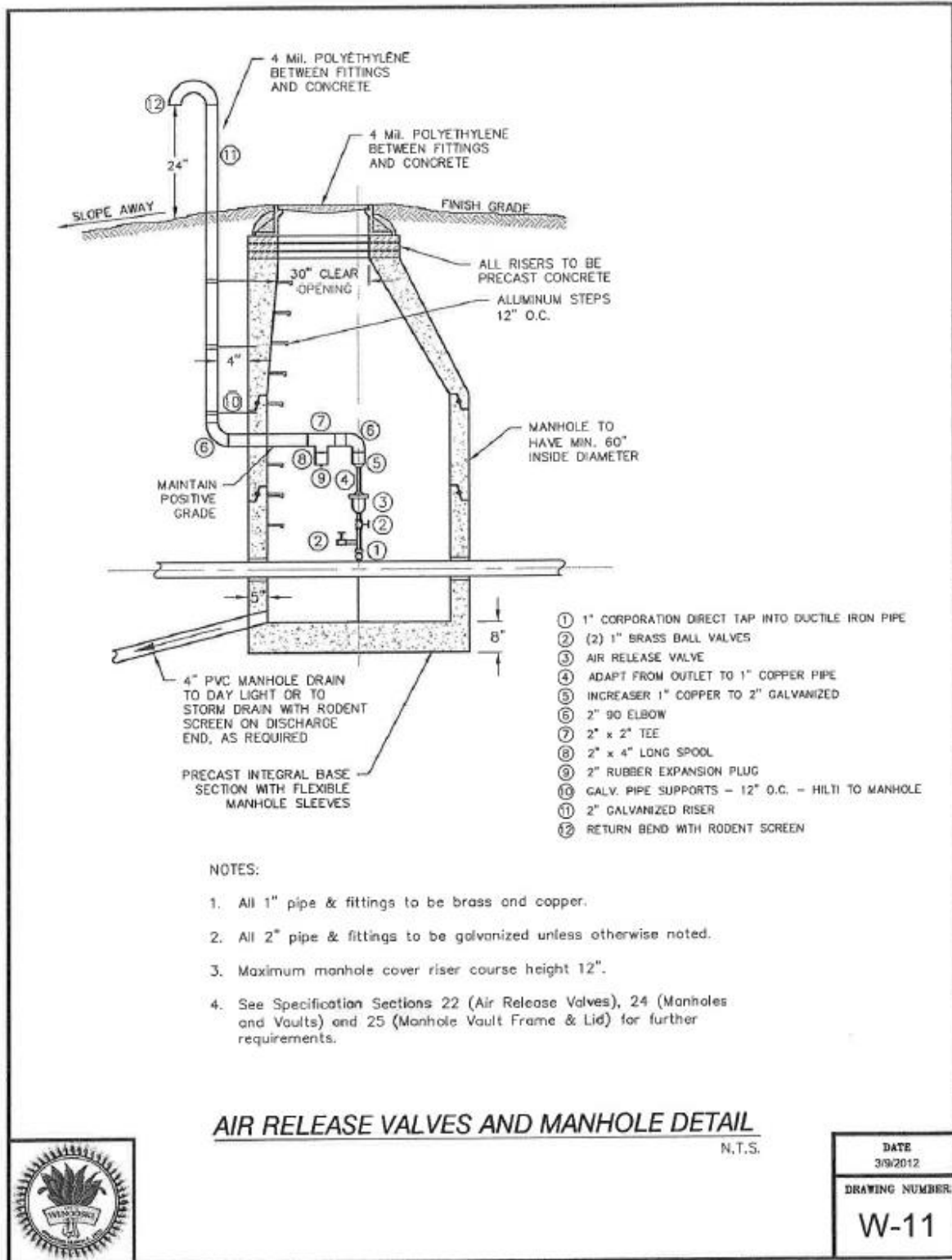


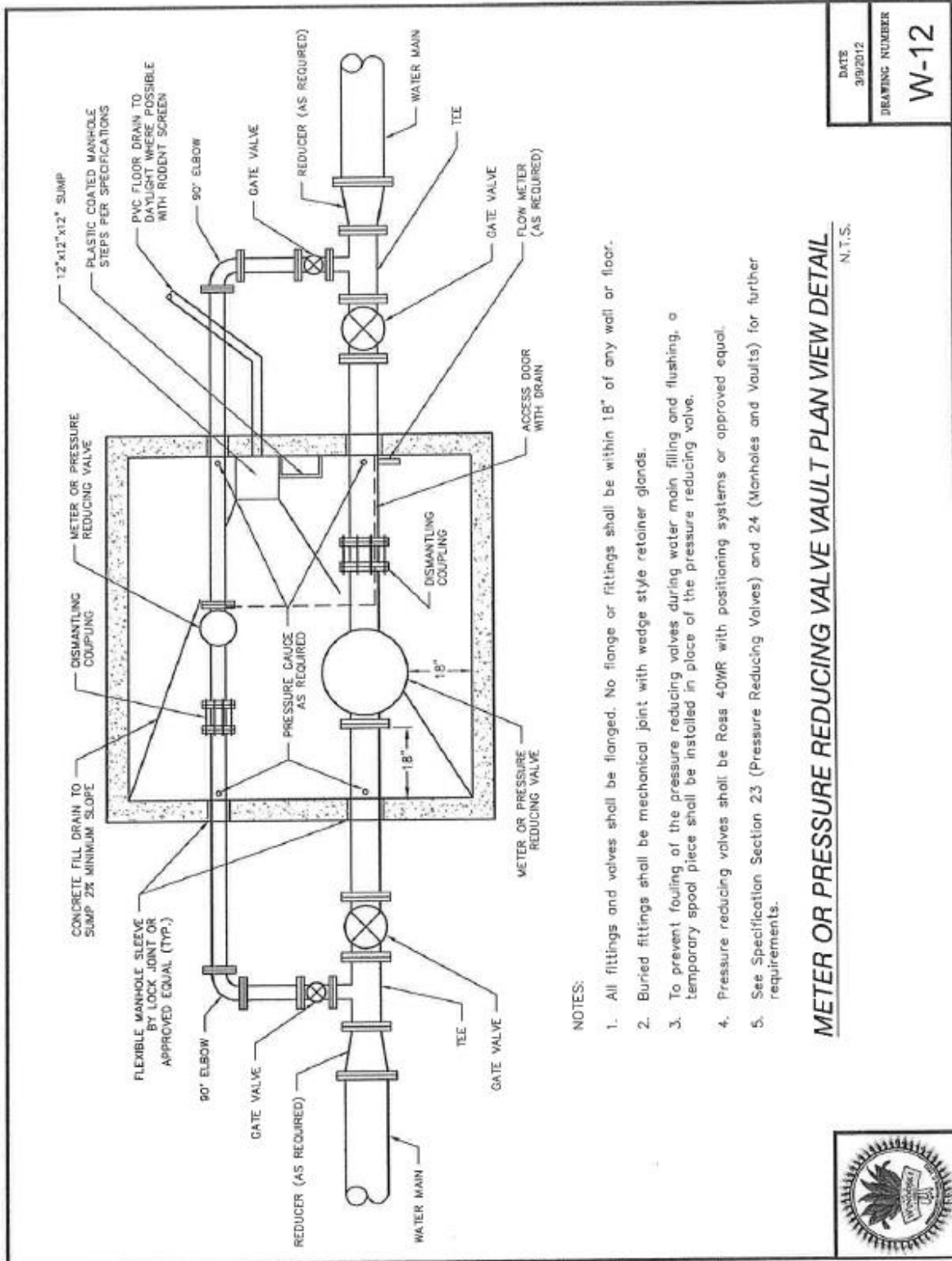










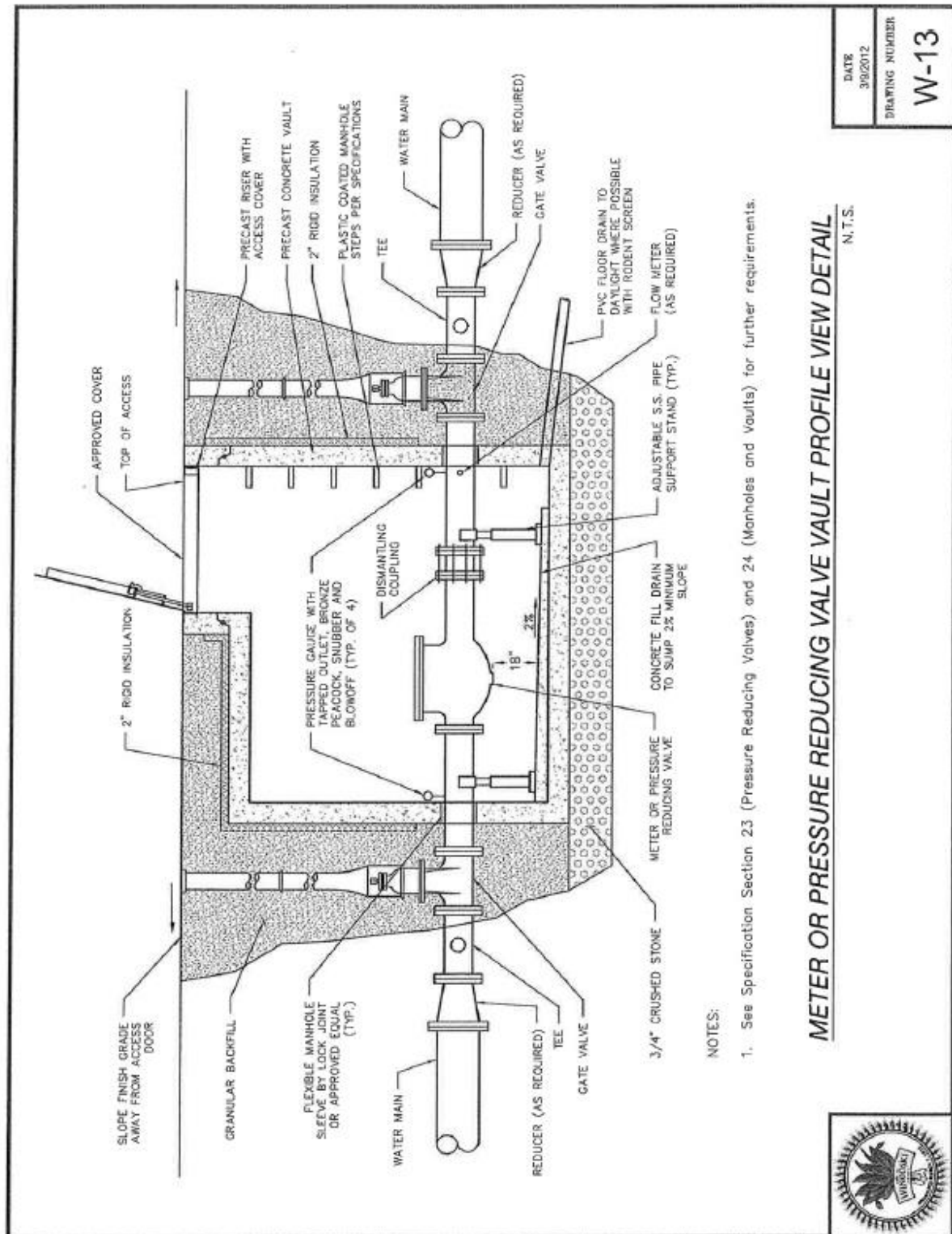


DATE  
3/9/2012

DRAWING NUMBER

W-12





**MINIMUM AREA OF BEARING SURFACE OF CONC. THRUST BLOCKS**  
(IN SQUARE FEET)

3"			4"			6"			8"			12"			SOIL CONDITION	SAFE BEARING LOAD (PSF)	
ENDS & TEES	45° ELB.	225° ELB.	ENDS & TEES	45° ELB.	225° ELB.	ENDS & TEES	45° ELB.	225° ELB.	ENDS & TEES	45° ELB.	225° ELB.	ENDS & TEES	45° ELB.	225° ELB.			
0.5	0.5	0.5	0.5	1.0	0.5	1.0	1.5	1.0	0.5	2.0	2.5	1.5	1.0	4.0	5.5	3.0	1.5
1.0	1.0	1.0	0.5	1.5	2.0	1.0	0.5	3.0	4.0	2.0	1.0	4.5	6.5	3.5	2.0	10.0	14.0
1.0	1.5	1.0	0.5	2.0	2.5	1.5	1.0	3.5	5.0	3.0	1.5	6.0	8.5	5.0	2.5	13.0	18.5
1.5	2.5	1.5	1.0	2.5	3.5	2.0	1.0	5.5	7.5	4.0	2.0	9.0	13.0	7.0	3.5	20.0	27.5
3.0	4.5	2.5	1.5	5.0	7.0	4.0	2.0	10.5	15.0	8.0	4.0	18.0	25.0	14.0	7.0	39.0	55.0
MAXIMUM WATER PRESSURE = 300 PSI NOTE: REDUCER BEARING AREA = 45° BEND OF LARGER PIPE																	
SOFT CLAY																	

## NOTES:

1. See Specification Section 26 (Concrete for Thrust Blocks) for further requirements.

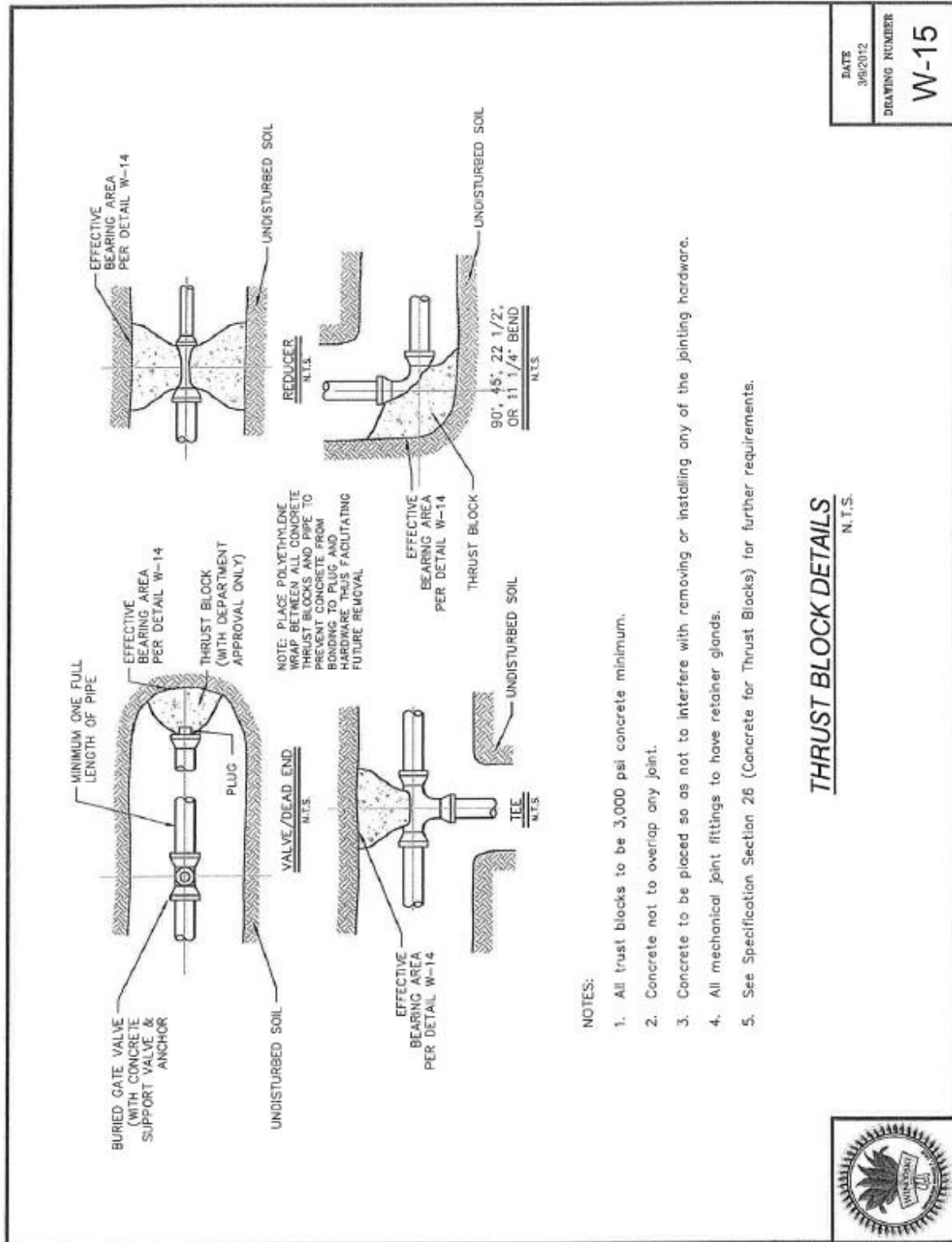
### THRUST BLOCK REQUIREMENT DETAIL

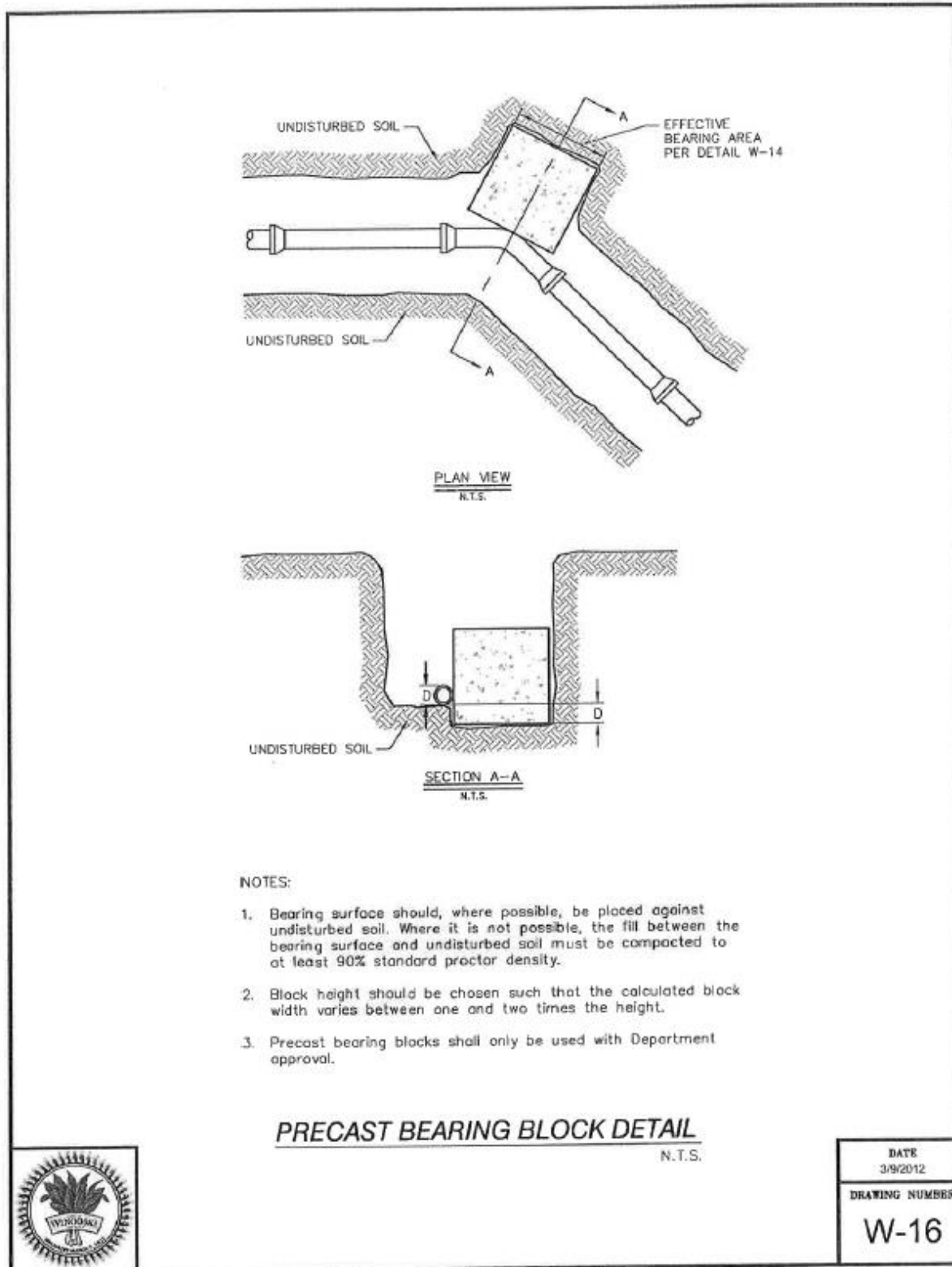
N.T.S.

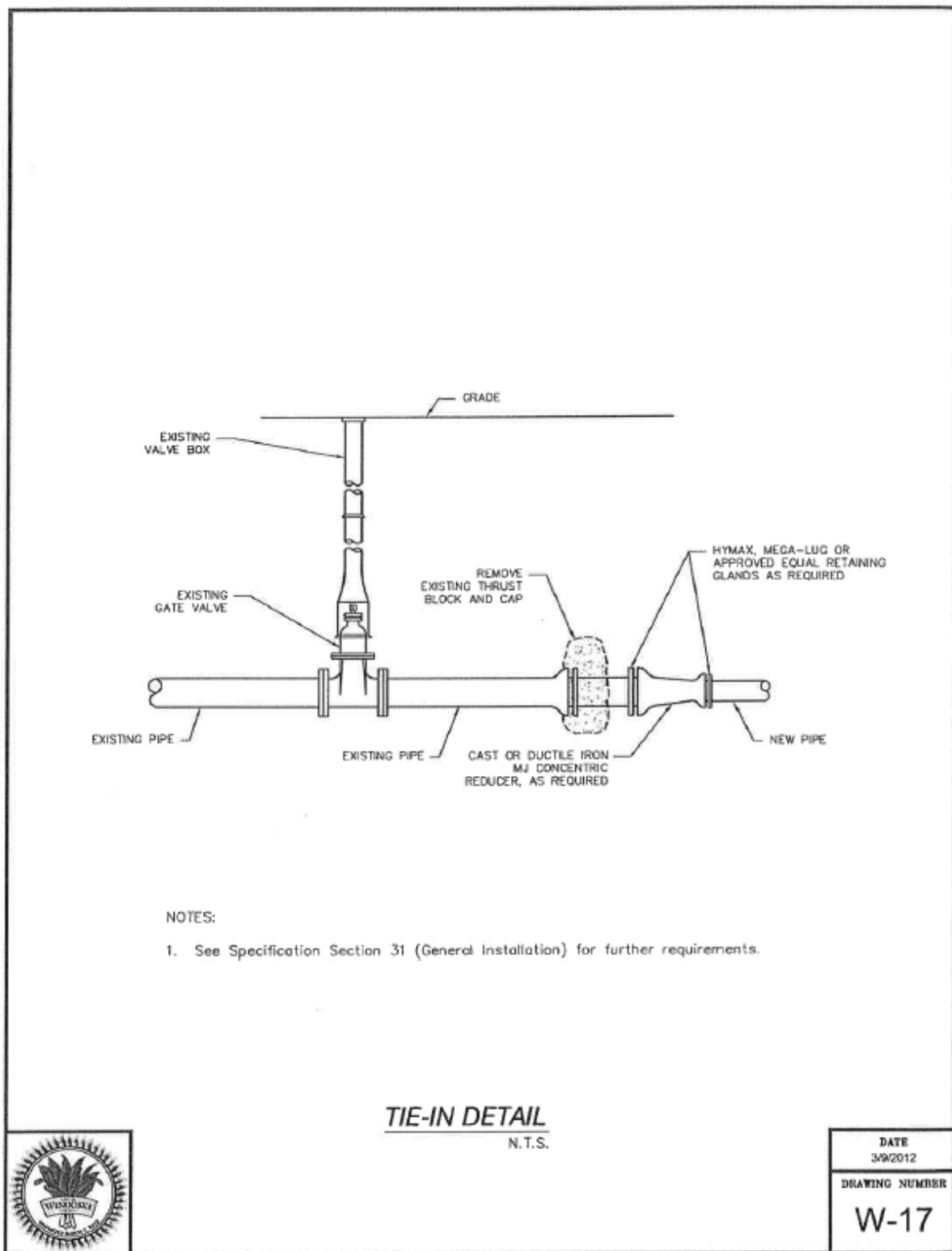
DATE  
3/9/2012

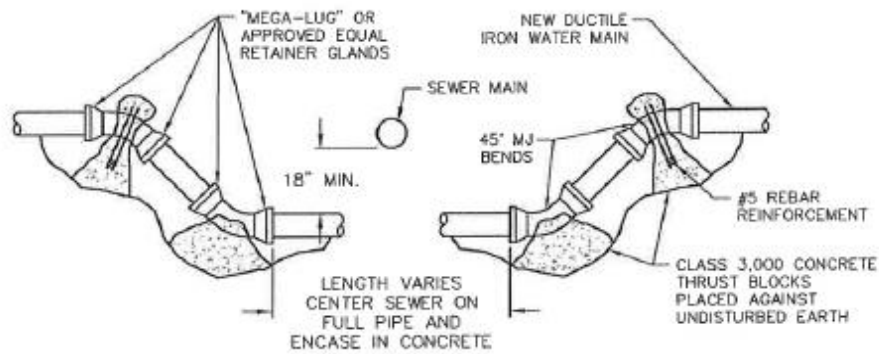
DRAWING NUMBER

W-14









## NOTES:

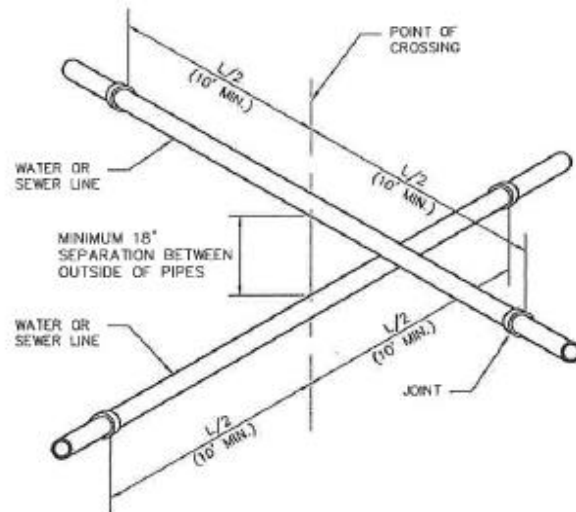
1. Detail to be employed when water cannot cross above sewer line.
2. Prior to pouring thrust blocks, all fittings are to be wrapped with 4 mil. polyethylene with Department approval only.
3. See Specification Section 3.3 (Water/Sewer Separation) for further requirements.

WATER UNDER SEWER LINE CROSSING DETAIL

N.T.S.



DATE 3/9/2012
DRAWING NUMBER W-18



## NOTES:

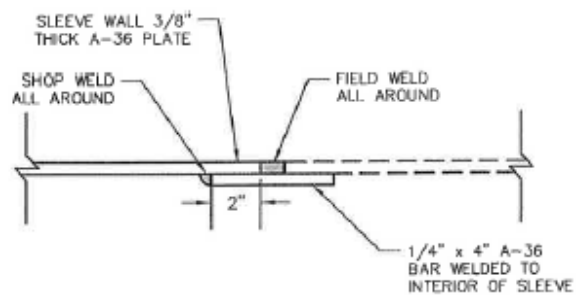
1. At crossings, one full length of water/sewer pipe shall be located so both joints will be as far from the water/sewer crossing as possible.
2. Whenever possible, install the sewer main below the water main to minimize the chance for contamination.
3. Water mains and sewer lines or manholes shall have at least 10' horizontal separation. This distance shall be measured edge to edge.
4. Maintain 10' minimum horizontal separation between the sewer line and water line.
5. Concrete encasement shall only be installed with Department approval.
6. See Specification Section 33 (Water/Sewer Separation) for further requirements.

**WATER/SEWER LINE CROSSING DETAIL**

N.T.S.



DATE 3/9/2012
DRAWING NUMBER <b>W-19</b>



## NOTES:

1. See Specification Section 34 (Sleeve, Jack & Bore) and 35 (Execution of Sleeve Jack & Bore) for further requirements.

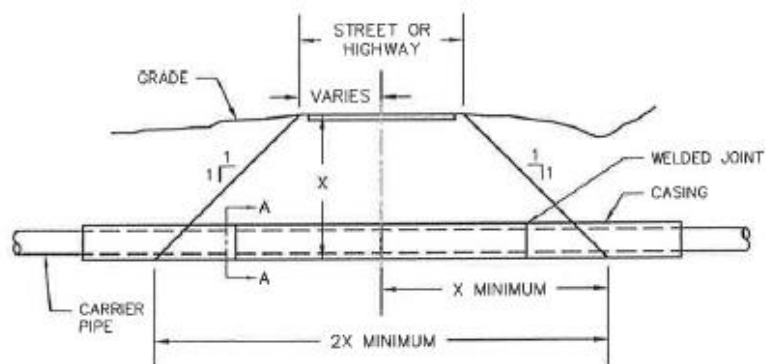
**STEEL SLEEVE ENCASEMENT JOINT WELD DETAIL**

N.T.S.

DATE  
3/9/2012

DRAWING NUMBER

W-20



NOTES:

1. See detail W-20 for joint weld detail.
2. See detail W-22 for casing spacer detail.
3. Minimum length of casing on highway bores is determined from shoulder point of road at a one on one slope.
4. Seal both ends of sleeve to prevent infiltration.
5. A weep hole shall be installed in the lower end of the sleeve for drainage.
6. See Specification Section 34 (Sleeve, Jack & Bore) and 35 (Execution of Sleeve Jack & Bore) for further requirements.

### STEEL SLEEVE ENCASEMENT DETAIL

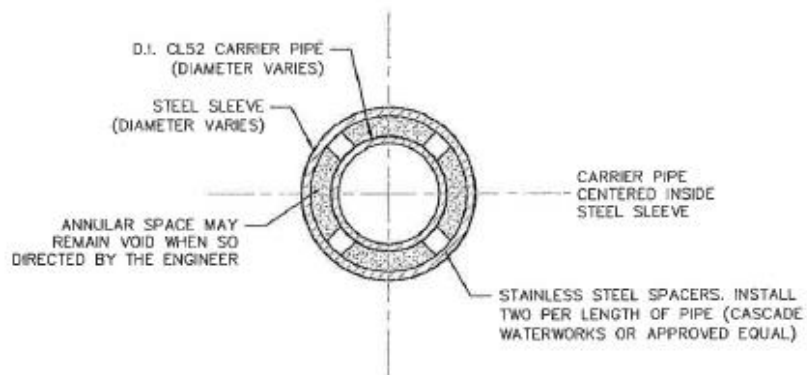
N.T.S.



DATE  
3/9/2012

DRAWING NUMBER:

W-21



## NOTES:

1. Seal both ends of the sleeve to prevent infiltration.
2. See Specification Section 36 (Casing Spacers) for further requirements.

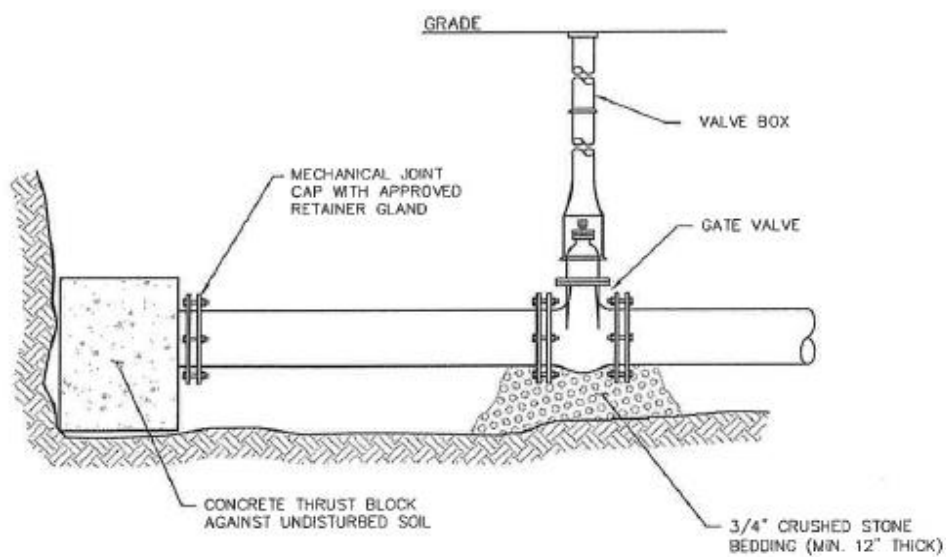
**STEEL SLEEVE CASING SPACER DETAIL**

N.T.S.

DATE  
3/9/2012

DRAWING NUMBER

W-22



## NOTES:

1. Bearing surface should, where possible, be placed against undisturbed soil. Where it is not possible, the fill between the bearing surface and undisturbed soil must be compacted to at least 90% standard proctor density.
2. Block height should be chosen such that the calculated block width varies between one and two times the height.
3. Precast bearing blocks shall only be used with Department approval.

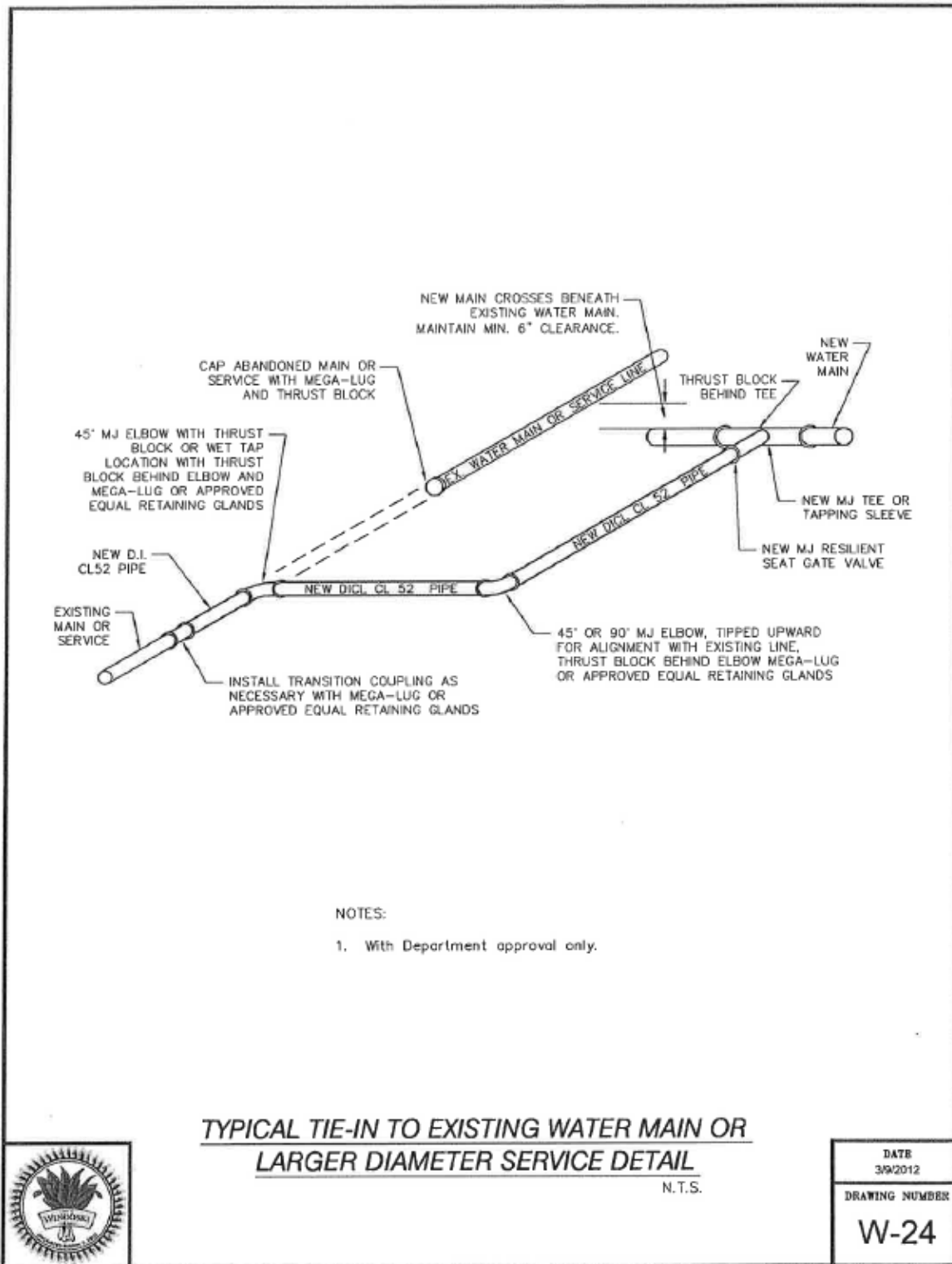
TYPICAL END OF LINE PIPE ANCHOR DETAIL

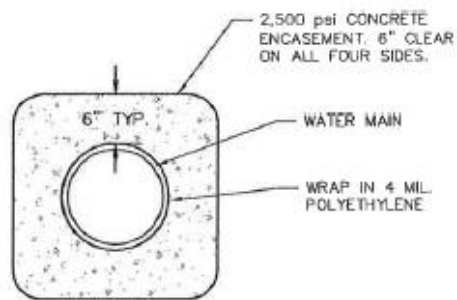
N.T.S.

DATE  
3/9/2012

DRAWING NUMBER:

W-23





## NOTES:

1. With Department approval only.

CONCRETE ENCASEMENT DETAIL

N.T.S.



DATE
3/9/2012
DRAWING NUMBER
W-25

**END OF SECTION**

## SECTION 4

### STORM DRAINAGE SYSTEMS

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## SECTION 4 STORM DRAINAGE SYSTEMS

### GENERAL

4.1 It is not intended by the City of Winooski that this “Section” be a complete set of specifications. It is to be used as a basic standard for any person planning work in Winooski. All materials listed shall be acceptable to the Director of Public Works and any items not listed will require written acceptance by the Director of Public Works before installation. Failure to receive written acceptance of materials and methods prior to their incorporation into the work shall leave the person having said work done liable for the replacement of those substandard materials with acceptable materials at his/her expense.

The person(s) proposing extensions or alterations to the existing stormwater system shall be responsible for complying with all applicable rules, regulations, and ordinances (local, state, federal). Said persons shall submit all necessary documentation, including but not limited to, plans, details and drawings, specifications, permits and applications and shall have obtained all acceptances and paid all applicable fees.

All work in a development project shall have the Design/Project Engineer on site during construction who is hired by the Developer to see that construction is completed according to the approved plans and specifications. The inspector’s costs shall be borne by the Developer.

Upon completion of work, the Design Engineer shall submit to the City a certification report stating that the work has been completed according to the approved design and all required tests have been passed. Copies of all tests and test results shall be submitted to the City along with corrective procedures as directed by the municipality and Design Engineer.

All culvert sizes, material types, and culvert locations shall be clearly indicated on the proposed project design and accepted by the Director of Public Works prior to installation.

When sizing culverts and storm drainage systems, the Developer must make detailed storm water flow analysis calculations. The City may request copies of the analysis to review prior to acceptance. All storm water flow analysis shall be designed by a licensed Professional Engineer, registered in the State of Vermont, and shall be in

accordance with the requirements in the Vermont Stormwater Management Manual, Volumes I and II, latest editions.

Storm water ponds and other treatment facilities will not be deeded over to the City nor will the City maintain or repair them. A property owner's association must be created and is responsible for all costs associated with any ponds. Ponds and other stormwater treatment facilities shall be enclosed with six (6) foot high chain link fence in all cases, unless waived by the Department of Public Works.

## **MATERIALS**

### **4.2.1 Pipe**

Storm drainage pipes shall be HDPE conforming to ASTM D3350 minimum cell classification 335420C for 15" through 60" diameters. Pipe shall have a smooth interior with annular exterior corrugations. Pipe shall have silt tight and leak resistant joints for non-pressure gravity flow drainage applications.

All storm drainage pipes shall have a minimum diameter of 15".

Underdrain pipes shall be PVC SDR 35 perforated pipe with two rows of ½" diameter holes at 5" on center. The underdrain pipes shall have a minimum diameter of 6" and all fittings shall be manufactured PVC SDR 35 gravity sewer fittings.

### **4.2.2 Culverts**

Roadway and driveway culverts shall be HDPE pipe conforming to ASTM D3350 minimum cell classification 335420C for 15" through 60" diameters. Pipe shall have a smooth interior with annular exterior corrugations. Pipe shall have silt tight and leak resistant joints for non-pressure gravity flow drainage applications.

All roadway and driveway culverts shall have a minimum diameter of 15".

### **4.2.3 Catch Basins**

Catch basins shall be round precast reinforced concrete structures with a monolithic base as manufactured by S.D. Ireland Brothers, Camp Precast, or accepted equal. The catch basins shall have a minimum 36" diameter, but for structures with more than two (2) pipe penetrations (not including underdrain

pipe penetrations), the catch basin diameter shall be a minimum of 48". Catch basins located within the travelled way shall be designed and constructed to handle an 8 ton (H-20) loading.

Catch basins shall be sized such that:

- At any elevation, a minimum of 60% of the circumference shall be concrete.
- The minimum distance, as measured along the circumference, between two (2) openings shall be 6".
- The structures shall also meet the minimum requirements of Table 4.1.

**Table 4.1**

**Catch Basin Minimum Requirements**

<b>Catch Basin Diameter</b>	<b>Largest Pipe Diameter Allowed</b>	<b>Sidewall Thickness</b>	<b>Concrete Cover Thickness</b>
36"	18"	4"	8"
48"	30"	5"	8"
60"	36"	6"	8"
72"	48"	7"	8"

Flexible manhole sleeves manufactured by Lock Joint or acceptable equal, and shall be provided at all inlet and outlet pipe penetrations to create a watertight joint. Manufacturer approved adapters shall be used for corrugated HDPE pipe.

Underdrain pipes shall run continuously from structure to structure to minimize the need for cleanouts. The underdrain pipes shall enter and exit the structures whenever possible, and be located a **at or above the top of the structure outlet pipe** Catch basin frames and grates shall be 24" x 24" square, Model No. R-3588 as manufactured by Neenah Foundry or accepted equal. A three (3) flange frame and grate shall be installed adjacent to curbs.

#### **4.2.4 Storm Manholes**

Manholes shall be round precast reinforced concrete structures with a monolithic base as manufactured by S.D. Ireland Brothers, Camp Precast, or

accepted equal. All drainage manholes shall have a minimum 48" diameter. All storm manholes located within the travelled way shall be designed and constructed to handle an 8 ton (H-20) loading.

Flexible manhole sleeves manufactured by Lock Joint or accepted equal shall be provided at all mainline inlet and outlet pipe penetrations to create a watertight joint. Manufacturer approved adapters shall be used for corrugated HDPE pipe.

Underdrain pipes shall run continuously from structure to structure to minimize the need for cleanouts. The underdrain pipes shall enter and exit the structures whenever possible.

Manhole covers and frames shall be 30" diameter, Model No. R-1642 as manufactured by Neenah Foundry or accepted equal. The cover shall have the word "Storm" cast into it.

#### **4.2.5 Stone Fill**

Stone used to stabilize ditches shall be of sufficient size for the purpose intended, but will be a minimum size of 12" and conform to VTrans Standards "Type II Stone Fill" 706.04b.

Stone fill and riprap shall be as defined by VTrans Standards for stone fill 706.04 and riprap 706.03. Stone fill and riprap shall be placed according to VTrans Specifications 613.

### **4.3**

#### **INSTALLATION**

Roadside drainage ditches shall be constructed to a minimum depth of 6" below the road subbase.

Side slopes of ditches shall be a maximum of two (2) foot horizontal to one (1) foot vertical. Grade of centerline of ditch shall be generally the same as roads.

### **4.4**

Ditches with centerline grade more than 5% shall have stone fill or riprap placed to stabilize.

#### **FOUNDATION DRAINS**

Foundation drains from either residential or commercial properties are prohibited from discharging into the City roadway drainage or sewer system. The Design Engineer of

the project shall make every effort to design a system to accommodate foundation drain needs separate from the City street system.

#### **DRIVEWAY ACCESS CULVERT REPLACEMENT OR MAINTENANCE**

The Winooski Department of Public Works shall not replace or maintain any drive access culverts serving private drive or private streets unless one of the following two

**4.5** conditions exists:

- The need to replace or maintain the culvert is due to a direct action of the Winooski Department of Public Works such as a change on the ditch line, reconstruction of the roadway or widening of the paved or graveled surface of the roadway.
- The original driveway access culvert was installed under a condition that required the Winooski Department of Public Works to maintain in the future or some other written agreement that specifically commits the Winooski Department of Public Works to maintain the culvert.

#### **END OF SECTION**

## SECTION 5

### STREETS

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## SECTION 5 STREETS

### GENERAL

5.1 It is not intended by the City of Winooski that this “Section” be a complete set of specifications. It is to be used as a basic standard for any person planning work in Winooski. All materials listed shall be acceptable to the Director of Public Works and any items not listed will require written acceptance by the Director of Public Works before installation. Failure to receive written acceptance of materials and methods prior to their incorporation into the work shall leave the person having said work done liable for the replacement of those substandard materials with acceptable materials at his/her expense.

The person(s) proposing extensions or alterations to the existing highway system shall be responsible for complying with all applicable rules, regulations, and ordinances (local, state, federal). Said persons shall submit all necessary documentation, including but not limited to, plans, details and drawings, specifications, permits and applications and shall have obtained all acceptances and paid all applicable fees.

All work in a development project shall have the Design/Project Engineer, hired by the Developer, onsite during construction ~~that is hired by the Developer~~ to see that construction is completed according to the approved plans and specifications. The Inspector’s costs shall be borne by the Developer.

Upon completion of work, the Design/Project Engineer shall submit to the City a certification report stating that the work has been completed according to approved design and all required tests have been passed. Copies of all tests and test results shall be submitted to the City along with corrective procedures as directed by the ~~municipality~~City and Design Engineer.

Roadways shall be deeded to the City three (3) years after a final inspection by the City has indicated the roadways are complete. During this three (3) year “warranty period”, the Developer is responsible for all maintenance and repairs of work. ~~The City may elect to perform winter maintenance on the roads during the warranty period if so requested in writing by the Developer to the Director of Public Works and as long as the base course of asphalt has been constructed and a winter plow agreement has been executed.~~

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Decisions as to when the specified typical street details apply shall be made in accordance with the Winooski Transportation Master Plan, Appendix E and through a determination by the Director of Public Works.

All City roadways shall have a maximum speed limit of 25 mph, and shall comply with the requirements in city ordinances and regulations ~~Unified Development Bylaw~~. New streets shall be designed in accordance with the American Association of State Highways and Transportation Official's (AASHTO) Policy on the Geometric Design of Highways and Streets, latest edition.

The highway related design construction and materials are intended to conform with the appropriate standards of the State of Vermont Agency of Transportation (VTrans) "Road Design Manual", "Standard Specifications for Construction", latest edition, and the VTrans "Design Standards for Road and Bridge Construction", latest edition. Some standards contained in "The City of Winooski Public Works Standards" may differ with the VTrans Standards. In such cases, the more stringent shall apply. Construction standards are set at the highest level for all streets in the City.

## **5.2 DEFINITION OF TYPE**

Street types in the City of Winooski are based on the Transportation Master Plan, as accepted by City Council, the Gateways District regulating map, and the Unified Land Use and Development Regulation. These are defined as Neighborhood Streets, Collector Streets, and Gateway – Commercial/Industrial Streets. Private streets and drives that are streets designated to become City owned streets shall be constructed in accordance with their typology.

### **5.2.1 Neighborhood Streets**

Streets that primarily serve those that live or visit these areas. Streets serving single-family developments and collector streets serving multi-family developments shall be public unless conditions for private streets or private driveways are met.

### **5.2.2 Collector Streets**

Collector streets are those that carry higher traffic volumes on main transportation corridors connecting Neighborhood Streets to Gateways.

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Streets serving higher density development may be required to have sidewalks or recreation paths (or one of each) on both sides of the street. Sidewalks/path 6 feet wide or less shall be concrete and paths more than 6 feet wide shall be bituminous concrete.

### **5.2.3 Gateway – Commercial/Industrial**

Streets that serve as main transportation corridors into and out of the City. Construction standards and specifications reflect potential truck use and are set at the highest level for streets in the City.

### **5.2.4 Private Street**

The Development Review Board may allow minor streets within multi-family developments to become private upon submission of legal documents waiving future public maintenance and proof of adequate maintenance capability by a homeowner's association. Construction standards for private streets shall be the same as for dense or rural residential streets and space shall be provided for a minimum 64' wide right-of-way. Roadway subbase and pavement thickness requirements will not be reduced but standards for curbs, sidewalks, and road width, may be influenced by numbers of units served and other site layout issues. Determination will be made on a case by case basis by the Director of Public Works. All private streets shall execute a Private Roadway document.

### **5.2.5 Private Driveway**

A maximum of two (2) rear lots without public road frontage may be served by a private driveway. Additionally, a private driveway may replace direct road access for two (2) abutting lots with existing public road frontage (60-foot minimum frontage).

## **5.3**

Driveways shall comply with the requirements on the Typical Residential Drive Detail and Profile, and sight distances for a private driveway shall comply with the most recent VTrans Standard B-71.

## **MATERIALS**

### **5.3.1 Geotextile Fabrics**

Soil stabilization fabric shall be a woven geotextile Type 600X as manufactured

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by Mirafi or acceptable equal, and shall be in accordance with VTrans Section 720. The fabric shall comply with the following specifications; a minimum grab tensile strength of 345 lbs., a maximum grab tensile elongation of 30%, a minimum burst strength of 650 psi, and minimum puncture resistance of 170 lbs.

The stabilization fabric shall be installed in accordance with the manufacturer's instruction with a minimum 24" overlap at any joints or seams.

Drainage fabric for wrapping underdrain trenches shall be a non-woven geotextile Type 140NS as manufactured by Mirafi or acceptable equal, and shall be in accordance with VTrans Section 720. The fabric shall comply with the following specifications; a minimum grab tensile strength of 130 lbs, a maximum grab tensile elongation of 50%, a minimum burst strength of 160 lbs., and a minimum puncture resistance of 40 lbs.

### **5.3.2 Subbase**

Subbase materials for roadways and sidewalks shall meet the requirements of VTrans Section 703 and 704.

### **5.3.3 Concrete**

Minimum compression strength of concrete used for curbs and sidewalks shall be VTrans Class B, 3500 psi. All concrete shall be in accordance with VTrans Section 501.

Handicapped sidewalk ramps shall be provided in accordance with VTrans Standard C-3 and ADA standards.

### **5.3.4 Bituminous Pavement**

Bituminous pavement for roadways shall meet the requirements of VTrans Section 406.

### **5.3.5 Street Signs**

Street signs shall be provided and installed by the Developer at all intersections of the project in accordance with these standards and the MUTCD, latest edition.

Street signs shall be the extruded type green with white letters, ASTM Type III or higher, both sides. Letter height shall be 6" and have 9" of blank space between the rows. All street signs shall be retroreflective.

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The sign post shall be located in the area between the curb and sidewalk at a point which will not interfere with pedestrian or vehicular travel, in accordance with the MUTCD, latest edition.

### **5.3.6 Traffic Signals**

Traffic signals shall include the following minimum requirements:

- Minimum 9 phase controller inground mounted box.
- Exclusive left turn signals for each approach (or per Design Engineer recommendation).
- LED traffic lights;
- An exclusive pedestrian phase (or per Design Engineer recommendation).
- Pedestrian buttons and poles on each corner and for each sidewalk with audible alarm and ADA compliant pedestrian signal call (“bird call” type).
- Video or Radar Detection (or per Design Engineer recommendation).
- Programmable emergency vehicle pre-emption device mounted on arm (i.e. Opticom/or equal).
- Metal pole and mast arm (design to be accepted by Director of Public Works).
- All visible items: Color gloss black.
- LED signal heads (light weight plastic with flat reflective backplates and visors).
- Proper signage (all signage to use symbols rather than letters).
- LED street lights mounted on metal poles.
- Where conditions warrant, these specifications can be either made less or more stringent by the Director of Public Works.
- All other aspects shall be in conformance to the latest standards of VTrans.
- Meter socket on its own support.
- LED “No Turn On Red” signs.
- Railroad Per-emption equipment as necessary.
- Communications equipment as necessary.

### **5.3.7 Pavement Markings**

Pavement markings shall be in accordance to VTrans Pavement Markings and Optic Guidance (at the time of publication, the most recent edition is March 2017 or the successor document) and the MUTCD, latest edition.

### **5.3.8 Guardrail**

Steel beam guardrail is the only acceptable guardrail material and shall be provided in accordance with VTrans standard details. Posts shall be pressure

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treated (40 years) 8"x12"x6'.

Guardrail shall be built in accordance with VTrans Standards G-1 series "Steel Beam" guardrail, and VTrans Section 621. If design speed is greater than 40 mph, utilize G-14 or G-15 series.

Guardrails shall be installed when the height at the edge of shoulder is greater than five (5) feet and/or the embankment slope is steeper than a 3:1 as a minimum. At locations of guardrails, the shoulder shall be widened a minimum of three (3) feet. Guardrails can also be required at other appropriate locations as requested by the City.

Where slopes are 3:1 or flatter, guardrail may not be needed if the area at the bottom of the slope is free of hazards. Where slopes are 4:1 or flatter, guardrail is not normally required.

### **5.3.9 Monuments**

Right-of-way monuments shall be installed at all street corners, property corners, and all points of curve and/or tangency as shown on the approved plans.

Concrete monuments shall be cast in one piece 4"x4"x48" of class B concrete with four (4) reinforcing steel rods. The top shall have a marked center which shall be the point of reference.

Marble monuments shall be good quality white marble 4"x4"x48" and have a marked center on top to be used as a point of reference. Four (4) inch maximum above grade.

The monument shall be erected at locations indicated on the plans or as directed by the Design/Project Engineer. They shall be set vertically and as to depth so that the top of the monument is at or no more than four (4) inches above the established final grade. The monuments are to be set in place after all other street development is completed.

5.4

## **INSTALLATION**

### **5.4.1 Concrete**

Concrete shall be placed in accordance with VTrans Section 541 for structural concrete and Section 700.

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Minimum compressive strength, at 28 days, shall be:

- Class A: Not less than 4000 psi
- Class B: Not less than 3500 psi

All testing of structural concrete shall be paid for by the Developer.

All concrete shall be treated with a curing/preservation treatment within 15 minutes of the completion of the finishing process and again prior to November 1. Refer to VTrans Section 541 for the curing period for various concrete components.

No concrete will be placed in standing water.

When ambient temperature is less than 40°F without specific acceptance of the Director of Public Works; follow procedures outlined in Recommended Practice for Cold Weather Concreting (ACI 306); or Hot Weather Concreting (ACI 305).

#### **5.4.2 Bituminous Pavement**

- Material and testing requirements for bituminous concrete shall conform to VTrans Standards for construction (latest edition).
- Base Courses – in accordance with VTrans Section 303, plant mixed material shall not be placed between **November 1 and May 1**. The material shall not be placed when the air temperature at the paving site in the shade and away from artificial heat is 40°F or lower. When it is in the public interest, the Director of Public Works may extend the dates of the paving season.
- Wear/Surface Courses – In accordance with VTrans Section 404 material shall be applied only when the following conditions prevail:
  - The atmosphere temperature is at least 45°F in the shade and rising.
  - The road surface and aggregate are sufficiently dry.
  - Weather conditions or other conditions are favorable and are expected to remain so for the performance of satisfactory work.
- Bituminous wear/surface courses shall not be applied between **October 15 and May 15** unless authorized in writing by the Director of Public Works.

#### **5.4.3 Lawns and Grassed Areas**

All areas of excavation and/or surface work which are on existing grassed lawn areas shall be restored to acceptable lawn area.

General procedure to be used in lawn restoration is:

- Apply a minimum of 4" of good topsoil over area to be seeded.
- Grade topsoil to blend with existing lawn areas.
- Fertilize with a non-phosphorus commercial fertilizer.
- Seed with a permanent high quality lawn grass seed at the rates shown in the following table.
- Mulch seeded area with straw mulch or apply temporary biodegradable erosion matting.

**Table 5.1**  
**Seeding Rates for Final Stabilization**

**Pure Live Seed**

<b>Choose from:</b>	<b>Variety</b>	<b>lbs./acre</b>	<b>lbs./1000 sq.ft.</b>
Birdsfoot trefoil	Empire/Pardee	5 <sup>(1)</sup>	0.10
or			
Common white clover	Common	8	0.20
plus			
Tall fescue	KY-31/Rebel	10	0.25
plus			
Redtop	Common	2	0.05
or			
Ryegrass (perennial)	Pennfine/Linn	5	0.10

**Notes:**

1. Mix 2.5 each of Empire and Pardee or 2.5 lbs. of Birdsfoot and 2.5 lbs. white clover per acre.
2. Further information provided in Rule 8 of the State of Vermont Low Risk Site Handbook for Erosion Prevention and Sediment Control, latest edition.

**5.5**

All areas of excavation and/or surface work which are grassed areas shall be restored to acceptable grass growth. Generally, grading, fertilizing, seeding, and mulching with acceptable materials will provide sufficient grass growth. An urban mix grass seed shall be used.

**TESTING**

**5.5.1 General**

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All testing shall be paid for by the Developer. If tests show that the materials do not meet the standards specified, the Developer shall make whatever corrections necessary to remedy the incorrect work and all additional testing required due to the incorrect work shall be paid for by the Developer.

### **5.5.2 Subbase and Granular Material**

To assure all materials used are as specified, the following testing procedures are required:

- Minimum of one (1) sieve analysis for each type of material shall be sampled for each 500 L.F. of roadway;
- Testing shall be done by an independent testing agency;
- Samples shall be taken by the Design/Project Engineer;
- Locations of the sampling shall be documented by the Design/Project Engineer and appear as roadway stationing on each sieve analysis result sheet;
- Samples shall be taken from road or from trucks on-site, as the road is being built;
- Samples shall be random and representative of material;
- Test results shall be submitted to the Public Works Department.

### **5.5.3 Concrete**

Testing for concrete curbs, sidewalks, and drive aprons shall be as follows:

- During the course of the work, compression test cylinders will be made and tested by a qualified testing laboratory. Test specimens shall be made, stored, and tested in accordance with ASTM C-31;
- Four (4) test specimens shall be made for each day's pour or a minimum of four (4) test specimens for each 50 cubic yards of concrete. One (1) cylinder shall be tested at seven (7) days and three (3) at twenty-eight (28) days. The Developer shall cooperate in the taking of test cylinders and provide suitable storage at the site for the test cylinders. Air contact test for each set of cylinders shall be taken and results provided to the Public Works Department.
- Test results shall be submitted to the Public Works Department.

### **5.5.4 Paving**

All testing associated with VTrans Standards, Section 406, will be required if, in

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the opinion of the City, the bituminous asphalt pavement being supplied and placed is not in accordance with the specifications.

**END OF SECTION**

## SECTION 6

### EROSION CONTROL MEASURES

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## SECTION 6 EROSION CONTROL MEASURES

### GENERAL

It is not intended by the City of Winooski that this “Section” be a complete set of specifications. It is to be used as a basic standard for any person planning work in Winooski. All materials listed shall be acceptable to the Director of Public Works and  
**6.1** any items not listed will require written acceptance by the Director of Public Works before installation. Failure to receive written acceptance of materials and methods prior to their incorporation into the work shall leave the person having said work done liable for the replacement of those substandard materials with acceptable materials at his/her expense.

The person(s) proposing any construction activity that disturbs  $\frac{1}{4}$  or more acres of land shall be responsible for complying with all applicable rules, regulations, and ordinances (local, state, federal). Said persons shall submit all necessary documentation, including but not limited to, plans, details and drawings, specifications, permits and applications and shall have obtained all City acceptances and paid all applicable fees.

All work on the project site shall have the Design/Project Engineer on site during construction who is hired by the Developer to see that construction is completed according to the approved plans and specifications. The inspector’s costs shall be borne by the Developer.

Erosion control measures for developments shall comply with the requirements in Unified Land Use and Development Regulations, Section 4.15, Stormwater Management and Control.

Low risk development as defined within, shall comply with the guidance in the State of Vermont Low Risk Handbook for Erosion and Sediment Control, latest edition. Erosion control measures for other developments shall comply with the standards in the Unified Land Use and Development Regulations and will require an Erosion and  
**6.2** Prevention and Sediment Control Plan in accordance with the Vermont Standards and Specifications for Erosion Prevention and Sediment Control Plan.

### MATERIALS

The materials for the temporary and permanent erosion control measures shall comply with the State of Vermont Low Risk Handbook for Erosion and Sediment Control and the Vermont Standards and Specifications for Erosion Prevention and Sediment Control Plan.

**INSTALLATION****6.3.1 Dust Control****6.3**

Water and/or calcium chloride shall be applied to travelled areas and stockpiles as construction progresses to control the dust. Blowing and accumulation of dust shall be controlled so that it does not become a nuisance to adjoining properties or cause a deterioration of surface water quality. The number of applications and the amount of water and chloride used shall be based on field and weather conditions and as ordered by the Director of Public Works.

**6.3.2 Dewatering**

All water flowing off the project site shall be free of sediment. Any water that accumulates on the project site within a trench or pit, or from dewatering activities, shall be properly treated to remove sediment prior to being discharged from the site.

**END OF SECTION**



## SECTION 7

### STREET LIGHTING SYSTEMS

## **SECTION 7 STREET LIGHTING SYSTEMS**

### **GENERAL**

This section provides specific technical standards and specifications for selection, installation and maintenance of City-owned street lighting systems.

- 7.1** It shall be the responsibility of the Developer and Contractor (hereinafter referred to as the Developer) to comply with all the provisions of this section and all applicable sections of the Green Mountain Power standards for installation of Customer owned street lighting systems. Where two or more sections of these Standards conflict, the Developer shall seek clarification and written acceptance from the Winooski Public Works Department.

Street Lights shall be installed in compliance with all applicable codes, standards, rules, regulations and ordinances (local, state, and federal). Said Developer shall submit all necessary documentation, including but not limited to, plans, drawings, details, permits and applications and shall have obtained all City acceptances and paid all applicable fees prior to commencing the project.

This section is intended as a design standard for any developer planning to install street lights in a present or proposed City Right-of-Way. All items supplied shall be acceptable to the City of Winooski Public Works Department. Materials, methods or workmanship not listed within this section will require written acceptance by the Director of Public Works before commencing the installation. Materials, methods or workmanship that do not meet these requirements shall be removed, replaced or repaired or otherwise brought into compliance with the provisions of this section by the Developer at his/her sole expense prior to acceptance of the system by the City.

The Developer shall provide for the Design/Project Engineer to be on site during construction to certify that construction is completed according to specifications. Electrical installations of street lights, feed cables and controllers shall be made under

- 7.2** the direct supervision of a qualified licensed Electrician. The cost of all supervision and inspections shall be borne by the Developer.

### **MATERIALS AND INSTALLATION**

#### **7.2.1 Lighting**

All proposed lights must be photo cell controlled, fully shielded, and installed at a maximum height of 25 feet.

- Light Fixture – Size and style to be specified and accepted on a per job basis. Fixtures must meet the current requirements of Municipal Soil-State Street

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Lighting Consortium (MSSLC) Model Specification for LED Roadway Luminaires, which is attached. See Section 7.8 for eligible manufacturers.

- Photo Cell – SELC 8483 part #8483004, SELC AcRo photocell for LED applications, (or accepted equal).
- Mast Arm – If used shall be 2" and suitable for use both in style and function with the proposed pole.
- Pole – To be specified and accepted on a per job basis. Regardless of the style all poles shall be salt resistant, utility grade, and designed to have a minimum 50 year life span. Poles should also be designed to withstand sustained 90 MPH wind load with a 1.3 peak factor; installations in areas that regularly experience sustained winds of 20 MPH or more should be reviewed and approved by the Design/Project Engineer to determine the appropriate strength of the pole and foundation.

### **7.2.2 Underground Lighting Circuit**

- Conduit system – All street lighting conductors shall be installed in 2" Schedule 40 PVC electrical conduit buried a minimum of 36" to the top of the pipe and installed in a 4" envelope of sand unless otherwise directed. Sweeps shall have a 36" minimum radius.
  - When roadway or utility crossings are encountered one of three options are allowed:
    - Concrete encased
    - Sleeved in a 3/8" wall thickness well casing
    - HDPE for boring under roadway
- Secondary Pedestals – Secondary junction points not occurring in the light pole shall be made above grade in a pedestal. Pedestal shall be Nordic #PSP-91330-MG or accepted equal.
- Connections – Connections in street light poles shall be a CU/AL rated bolted connection such as a tinned split bolt connector. Pedestal connectors shall be insulated bar type connectors (RNC #350-31) or accepted equal.
- Conductor – #6AWG, three wire, 600V URD cable.

### **7.2.3 Power Supply**

- Voltage – Typical voltage shall be 120/240V.
- Length of Run – No lights shall be installed more than 1,200 cable feet from the power source.
- Meter Socket – When required the meter socket shall conform to utility specifications (contact utility for details).

**SPECIFICATION FOR LED ROADWAY LUMINAIRES****7.3.1 Normative References****7.3**

The publications listed below form a part of this specification to the extent referenced. Publications are referenced within the text by their basic designation only. Versions listed shall be superseded by updated versions as they become available.

American National Standards Institute (ANSI)

- C78.377-2011 (or latest), American National Standard for the Chromaticity of Solid State Lighting Products
- C28.77-2002 (or latest), American National Standard for Harmonic Emission Limits – Related Power Quality Requirements for Lighting Equipment
- C136.2-2014 (or latest), American National Standard for Roadway and Area Lighting Equipment – Dielectric Withstand and Electrical Immunity Requirements
- C136.10-2010 (or latest), American National Standard for Roadway and Area Lighting Equipment – Locking-Type Photocontrol Devices and Mating Receptacles – Physical and Electrical Interchangeability and Testing
- C136.15-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment – Luminaire Field Identification
- C136.22-2004 R2009 (or latest), American National Standard for Roadway and Area Lighting Equipment – Internal Labeling of Luminaires
- C136.31-2010 (or latest), American National Standard for Roadway and Area Lighting Equipment – Luminaire Vibration
- C136.37-2011 (or latest), American National Standard for Roadway and Area Lighting Equipment – Solid State Light Sources Used in Roadway and Area Lighting

American Society for Testing and Materials International (ASTM)

- 
- D523-08 (or latest), Standard Test Method for Specular Gloss
  - D1654-08 (or latest), Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

Design Lights Consortium®

- Maintains list of products defining high energy efficiency standards of categories of commercial LED luminaires. Using listed luminaires does not guarantee product satisfaction or longevity, but it does define best efficacy.

Federal Communications Commission (FCC)

- 47 CFR Part 15, Telecommunication – Radio Frequency Devices

Federal Trade Commission (FTC)

- Complying with the Made in USA Standard, December 1998 (<http://business.ftc.gov/advertising-and-marketing/made-usa>)

Illuminating Engineering Society of North America (IESNA or IES)

- LM-50-13 (or latest), IES Approved Method for Photometric Measurement of Roadway and Street Lighting Installations
- LM-63-02 (R2008 or latest), ANSI/IESNA Standard File Format for the Electronic Transfer of Photometric Data and Related Information
- LM-79-08 (or latest), IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products
- LM-80-08 (or latest), IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources
- RP-8-14 (or latest), ANSI/IESNA American National Standard Practice for Roadway Lighting
- RP-16-10 (or latest), ANSI/IES Nomenclature and Definitions for Illuminating Engineering
- TM-15-11 (or latest), Luminaire Classification System for Outdoor Luminaires
- TM-21-11 (or latest), Projecting Long Term Lumen Maintenance of LED Light

## Sources

### LED Lighting Facts

- Submission Requirements  
(<http://www.lightingfacts.com/About/Content/Manufacturers/SubmissionRequirements>)

### Underwriters Laboratories (UL)

- 1598 Third Edition (or latest), Luminaires

### **7.3.2 Related Documents**

- Contract Drawings and conditions of Contract (including General Conditions, Addendum to the General Conditions, Special Conditions, Division 01 Specifications Sections and all other Contract Documents) apply to the work of this section.
- Companion specification for ANSI-compliant photocontrols.
- MSSLC Model Specification for Networked Outdoor Control Systems.

### **7.3.3 Definitions**

- Lighting terminology used herein is defined in IES RP-16, latest edition. See referenced documents for additional definitions.

Exception: The term “driver” is used herein to broadly cover both drivers and power supplies, where applicable.

Clarification: The term “LED light source(s)” is used herein per IES LM-80 and TM-21 to broadly cover LED package(s), module(s), and array(s).

### **7.3.4 Lighting Requirements**

- Summary of parameters and product criteria that is required for lighting design submission for each roadway type on a roadway lighting project.

Use table format provided for each light and pole combination.

**Luminaire Designation: “\_\_\_\_\_”**

**System Specification – To be calculated for each roadway type**

SITE PARAMETERS (See reference drawings in 0)		
Appendix D ROADWAY DATA	Median width (including curbs, gutters, and shoulders)	___ ft
	Number of vehicular lanes (total on both sides of median)	
	Width of one vehicular lane	___ ft
	Shoulder width (including gutter and curb)	___ ft
	IES pavement class.	<input type="checkbox"/> R1 <input type="checkbox"/> R2 <input type="checkbox"/> R3 <input type="checkbox"/> R4
SIDEWALK DATA	Berm width (from curb to sidewalk)	___ ft
	Sidewalk width	___ ft
	Sidewalk on	<input type="checkbox"/> Both sides of street <input type="checkbox"/> Pole side <input type="checkbox"/> Other side
LIGHT POLE DATA	Luminaire mounting height	___ ft
	Arm length (horizontal)	___ ft
	Luminaires per pole	
	Pole set-back from curb	___ ft
	Pole spacing (one pole cycle, parallel to path of travel)	___ ft
	Pole layout	<input type="checkbox"/> One side <input type="checkbox"/> Opposite <input type="checkbox"/> Staggered <input type="checkbox"/> Median
PERFORMANCE CRITERIA		
MAINTAINED ROADWAY ILLUMINATION (as per IESNA RP-8 for Road and Pedestrian Conflict Area. Residential streets with sidewalks do not require continuous streetlighting )		
PHOTOPIC ILLUMINANCE	Average horizontal illuminance at pavement	0.4 fc min
	Avg:min uniformity ratio	6.0 max

	1.1.3 Max:min uniformity ratio	20.0 max
MAINTAINED SIDEWALK ILLUMINATION		
PHOTOPIC ILLUMINANCE	Average horizontal at pavement	0.2 fc
	Avg:min uniformity ratio (horizontal)	4.0
	Min. vertical illum. at 4.9 ft, in directions of travel	0.1 fc
LED LUMINAIRE		
INPUT POWER	Max. nominal luminaire input power	___ W
VOLTAGE	Nominal luminaire input voltage (or range as applicable)	120-240 V
LUMEN MAINT.	Min. % of initial output at 36,000 hours operation	90%
WARRANTY	Min. luminaire warranty	5 years
NOMINAL CCT	Rated correlated color temperature	4100 ± 200 K
BUG RATINGS	Max. nominal backlight-uplight-glare ratings	B2-U1-G2
FINISH	Luminaire housing finish color	Silver or gray
WEIGHT	Luminaire weight	23-30 lb lb
EPA	Max. effective projected area	1.0 ft <sup>2</sup>
MOUNTING	Method	<input type="checkbox"/> Post-top <input type="checkbox"/> Side-arm <input type="checkbox"/> Trun./yoke <input type="checkbox"/> Swivel-tenon
	Tenon nominal pipe size (NPS)	___ inches
VIBRATION	ANSI C136.31	<input type="checkbox"/> Level 1 (normal) <input type="checkbox"/> Level 2 (bridge/overpass)
THERMAL ENVIRONMENT	Typical min. ambient temperature during operation	-20 °F
	Typical max. ambient temperature during operation	90 °F
ELECTRICAL IMMUNITY	ANSI C136.2 Comb. Wave Test Level	<input type="checkbox"/> Basic (6kV / 3kA) <input type="checkbox"/> Enhanced (10kV / 5kA) <input type="checkbox"/> Elevated (20kV / 10kA)
CONTROL INTERFACE	<input type="checkbox"/> None <input type="checkbox"/> ANSI C136.10 (3-pin) <input type="checkbox"/> ANSI C136.41, 5-pin <input type="checkbox"/> ANSI C136.41, 7-pin	

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LED DRIVER	<input type="checkbox"/> Not dimmable	<input type="checkbox"/> Dimmable, 0-10V (IEC 60929)	<input type="checkbox"/> Dimmable, DALI (IEC 62386)
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### 7.3.5 General Luminaire Requirements

Luminaires shall satisfy the key criteria summarized in 7.3.3.

Transmissive optical components shall be applied in accordance with OEM design guidelines to ensure suitability for the environment (e.g., electromagnetic, thermal, mechanical, chemical).

Luminaire shall be designed for ease of component replacement and end-of-life disassembly.

LED light source(s) and driver(s) shall be RoHS compliant.

Nominal luminaire input wattage shall account for nominal applied voltage and any reduction in driver efficiency due to sub-optimal driver loading.

Luminaire shall accept the voltage or voltage range specified at 50/60 Hz, and shall operate normally for input voltage fluctuations of plus or minus 10 percent.

All internal components shall be assembled and pre-wired using modular electrical connections.

The following shall be in accordance with corresponding sections of ANSI C136.37.

- Wiring and grounding

- Terminal blocks for incoming AC lines (electrical mains wires)

- Photocontrol receptacle

- Latching and hinging

- Mounting provisions

- Ingress protection

**7.3.6 Painted or Finished Luminaire Surfaces Exposed to the Environment**

Shall exceed a rating of six per ASTM D1654 after 1000 hours of testing per ASTM B117.

The coating shall exhibit no greater than 30% reduction of gloss per ASTM D523, after 500 hours of QUV testing at ASTM G154 Cycle 6.

**7.3.7 Thermal Management**

Luminaire shall start and operate in ambient temperature range specified.

Maximum rated case temperature of driver and other internal components shall not be exceeded when luminaire is operated in ambient temperature range specified.

Mechanical design of protruding external surfaces (heat sink fins) shall facilitate hose-down cleaning and discourage debris accumulation.

Liquids or other moving parts shall be clearly indicated in submittals, shall be consistent with product testing, and shall be subject to review by Owner.

**7.3.8 LED Driver, Photocontrol Receptacle, and Control Interface**

Luminaire designation(s) indicated "None" in Section 7.3.3 need not accept a control signal, and do not require a dimmable driver. If luminaire cannot be furnished without photocontrol receptacle, luminaire shall be furnished with ANSI C136.10 compliant photocontrol receptacle and shorting cap and directed by Owner.

Luminaire designation(s) indicated "ANSI C136.10, 3-pin" in Section 7.3.3 shall be fully prewired and shall incorporate an ANSI C136.10 compliant receptacle. If a dimmable LED driver is specified, its control wires shall be accessible and electrically isolated.

Luminaire designation(s) indicated "ANSI C136.41, 5-pin" in Section 7.3.3 shall be fully prewired and shall incorporate an ANSI C136.41 compliant receptacle. If a dimmable LED driver is specified, its 0-10V or DALI control wires shall be connected to the receptacle pads as specified in ANSI C136.41.

### 7.3.9 Electrical Safety Testing

Luminaire shall be listed for wet locations by a U.S. Occupational Safety Health Administration (OSHA) Nationally Recognized Testing Laboratory (NRTL).

Luminaire shall have locality-appropriate governing mark and certification.

Luminaire shall meet the performance requirements specified in ANSI C136.2 for dielectric withstand, using the DC test level and configuration.

### 7.3.10 Electrical Immunity

Luminaire shall meet the performance requirements specified in ANSI C136.2 for electrical immunity, using the combination wave test level indicated in Section 7.3.3.

Manufacturer shall indicate on submittal form (O) whether failure of the electrical immunity system can possibly result in disconnect of power to luminaire.

### 7.3.11 Interference and Power Quality

Luminaire shall comply with FCC 47 CFR part 15 interference criteria for Class A (non-residential) digital devices.

Luminaire shall comply with Section 5.2.5 (luminaires rated for outdoor use) of ANSI C82.77 at full input power and across specified voltage range.

### 7.3.12 Color Attributes

Color Rendering Index (CRI) shall be no less than 70.

Nominal Correlated Color Temperature (CCT) shall be as specified in Section 7.3.3.

If submitted nominal CCT is listed in Table 7.1 below, measured CCT and Duv shall be as listed in Table 7.1.

**Table 7.1** Allowable CCT and Duv (adapted from ANSI C78.377)

Manufacturer- Rated Nominal CCT (K)	Allowable IES LM-79 Chromaticity Values	
	Measured CCT (K)	Measured Duv

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2700	2580 to 2870	-0.006 to 0.006
3000	2870 to 3220	-0.006 to 0.006
3500	3220 to 3710	-0.005 to 0.007
4000	3710 to 4260	-0.005 to 0.007

If submitted nominal CCT is not listed in Table 7.1, measured CCT and Duv shall be as per the criteria for Flexible CCT defined in ANSI C78.377.

### **7.3.13 Identification**

Luminaire shall have an external label per ANSI C136.15.

Luminaire shall have an internal label per ANSI C136.22.

## **REQUIRED SUBMITTALS**

### **7.4**

#### **7.4.1 Completed Appendix B Submittal Form**

Family grouping in accordance with LED Lighting Facts is permitted, provided this is clearly indicated on the submittal form provided in Appendix B, and clearly communicated in the calculations.

#### **7.4.2 Product Cutsheets**

Luminaire Cutsheets

Cutsheets for LED light source(s)

Cutsheets for LED driver(s)

If dimmable LED driver is specified, provide diagrams illustrating light output and input power as a function of control signal.

Specification of surge protection device

#### **7.4.3 Instructions for Installation and Maintenance**

Manufacturer's instructions for installation and maintenance shall be included.

#### **7.4.4 Summary of Luminaire Recycled Content and Recyclability**

Shall be in accordance with the FTC Green Guides, as expressed as a percentage of luminaire weight.

**7.4.5 IES LM-79 Luminaire Photometric Report(s)**

Shall be produced by the test laboratory.

The test laboratory shall satisfy LED Lighting Facts accreditation requirements.

Shall include the following information:

Name of test laboratory

Report Number

Date

Complete luminaire catalog number

Description of luminaire, LED light source(s), and LED driver(s)

Goniophotometry

IES TM-15 Backlight-Uplight-Glare (BUG) ratings shall be for initial (worst-case) values, i.e., Light Loss Factor (LLF) = 1.0.

**7.4.6 Roadway Lighting Calculations and Supporting Test Data**

Computer-generated point-by-point photometric analysis of maintained light levels.

Calculation/measurement points shall be per IES RP-8.

Calculations shall be for maintained values, i.e. Light Loss Factor (LLF) < 1.0, where  $LLF = LLD \times LDD \times LATF$ , and

Lamp Lumen Depreciation (LLD) shall be 0.90 or the value calculated in Section 7.4.6, whichever is lower.

Luminaire Dirt Depreciation (LDD) = 0.90

Luminaire Ambient Temperature Factor (LATF) = 0.96

Mesopic multipliers (i.e., effective luminance factors) shall not be used. All values shall assume photopic visual adaptation.

**7.4.7 Written Product Warranty Per Section 7.6**

In conformance with Section 7.6, written product warranties must be submitted as part of the required documentation.

#### **7.4.8 Safety Certification and File Number Indicating Compliance with UL 1598**

Applicable testing bodies are determined by the US Occupational Safety Health Administration (OSHA) as Nationally Recognized Testing Laboratories (NRTL) and include: CSA (Canadian Standards Association), ETL (Edison Testing Laboratory), and UL (Underwriters Laboratory).

### **QUALITY ASSURANCE**

- 7.5** Before approval and purchase, Owner may request luminaire sample(s) identical to product configuration(s) submitted for inspection. Owner may request IES LM-79 testing of luminaire sample(s) to verify performance is within manufacturer-reported tolerances.

Electrically test fully assembled luminaires before shipment from factory.

### **7.6 WARRANTY**

Warranty shall be of the minimum duration specified in Section 7.3, and shall cover maintained integrity and functionality of the following:

Luminaire housing, wiring, and connections.

LED light source(s) negligible light output from more than 10 percent of the LED packages constitutes luminaire failure.

LED driver(s).

- 7.7** Warranty period shall begin 90 days after date of invoice, or as negotiated by owner such as in the case of an auditable asset management system.

### **7.8 MANUFACTURER SERVICES**

Manufacturer or local sales representative shall provide installation and troubleshooting support via telephone and/or email.

### **ELIGIBLE MANUFACTURERS**

For the designated downtown streets, the city standard is Kim Lighting Era RA17 and RA25. Type 3 distribution typical for poles on one side of street, E35 PicoEmitter, 4000K in Platinum Silver. Arm is Side Pole Swept Cast.

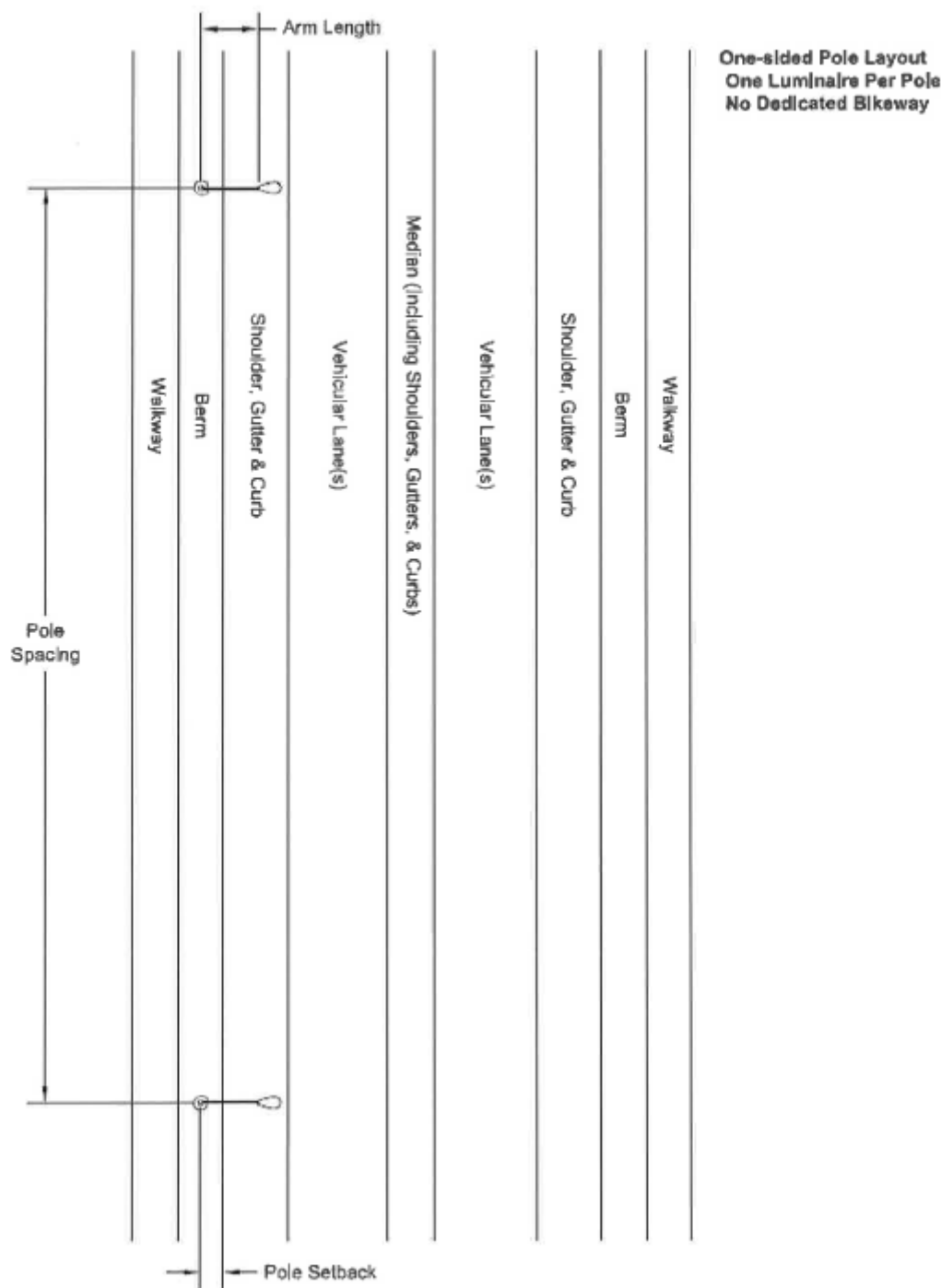
For city street locations outside the designated downtown, the standard is Cree LEDway Series STR-LWY with horizontal tenon mount in Type 3M distribution, Series E UL, in Silver.

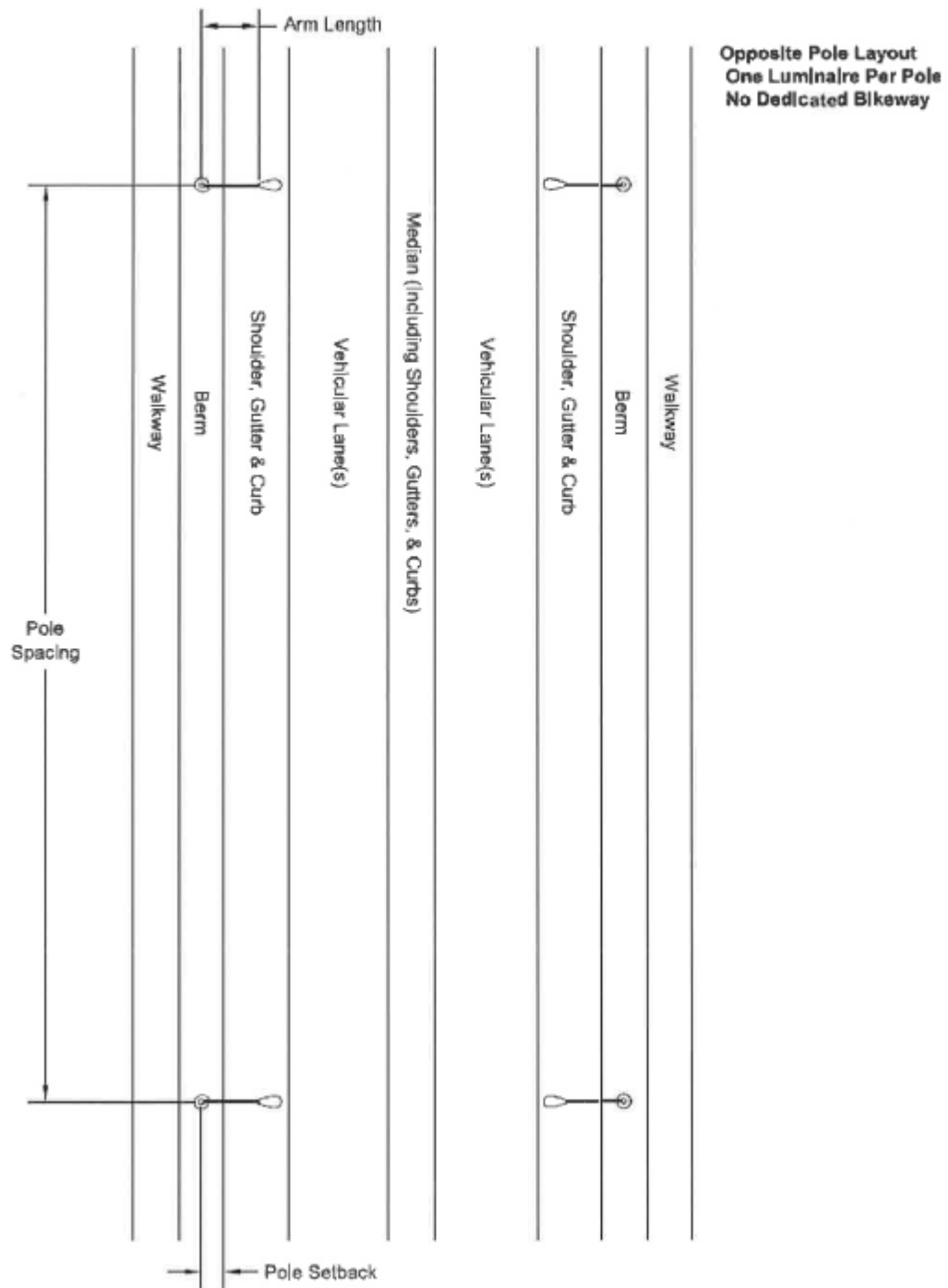
Any manufacturer offering products that comply with the required product performance and operation criteria may be considered. Proof of compliance is with the manufacturer. All requested data must be submitted to the City Public Works Manager for review by a professional lighting designer.

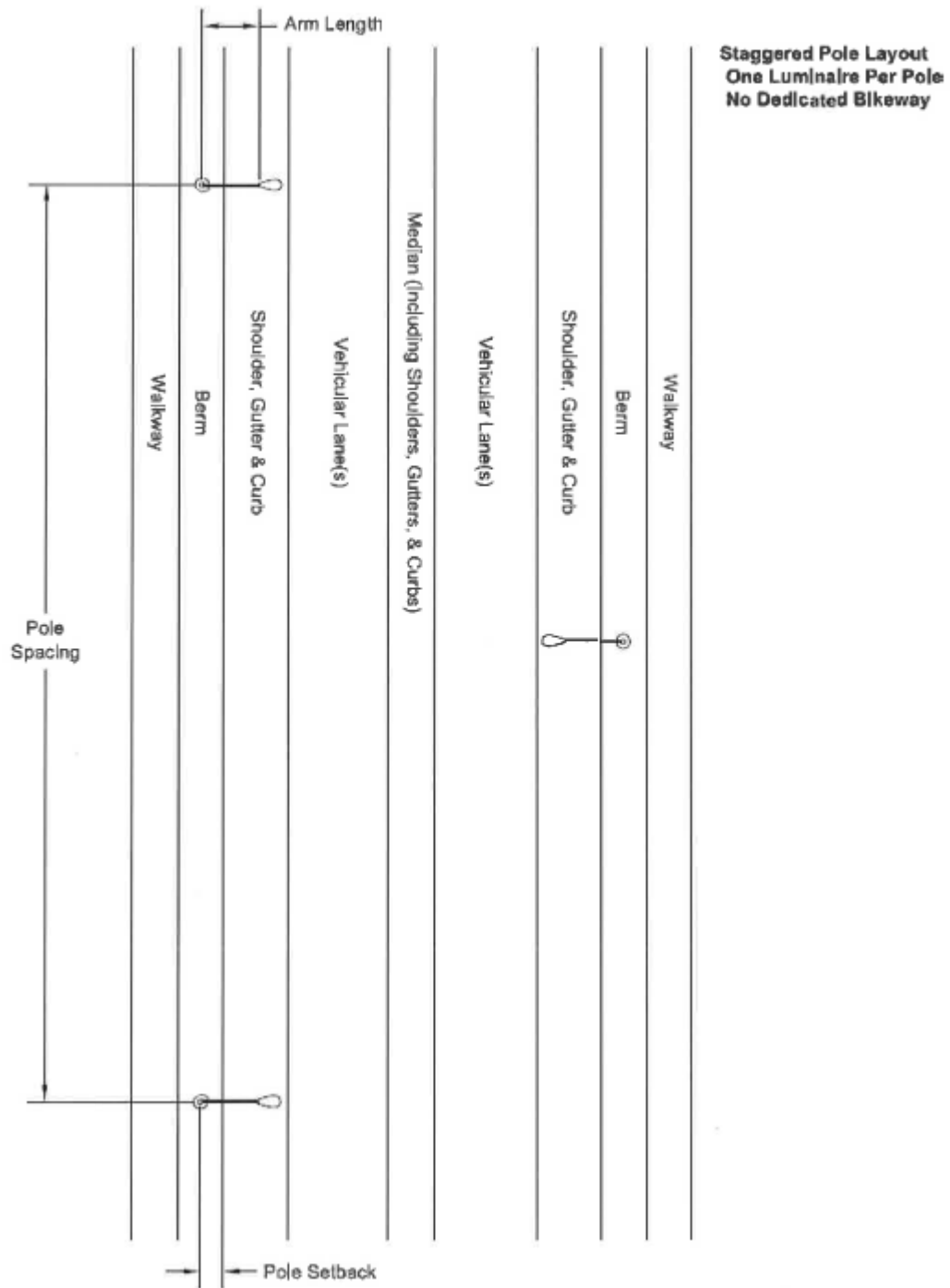
### **Appendix A – Pole Layout Illustrations**

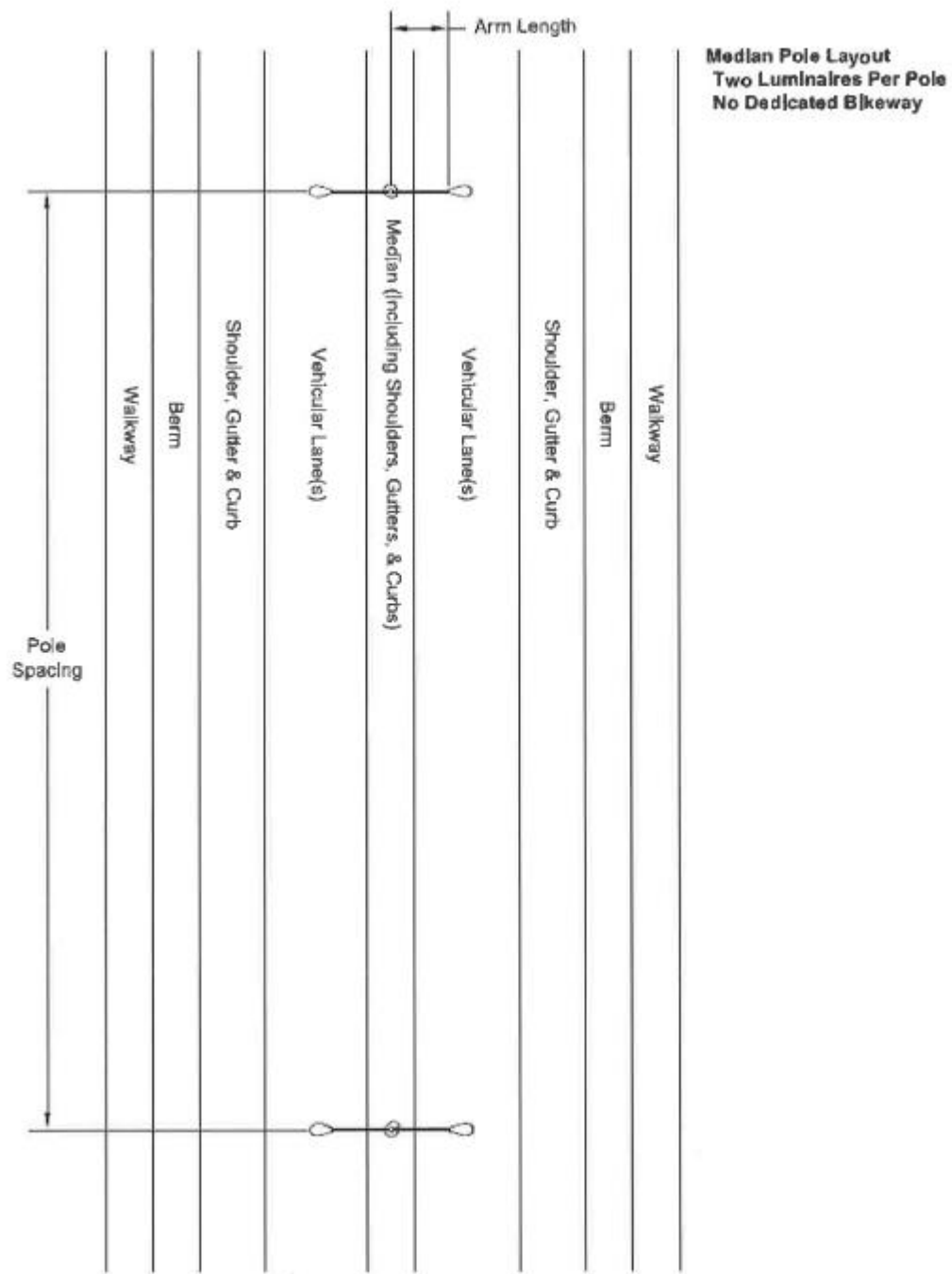
The plan-view drawings provided on the following pages illustrate pole layouts indicated in the “system” specification method of Section 7.3.3. These drawings are not to scale.











### Appendix B – Product Submittal Form

Luminaire designation				
Luminaire manufacturer				
Luminaire model number				
Nominal IES TM-15 BUG ratings	B =	U =	G =	
Product family testing	<input type="checkbox"/> Submitted product is identical to tested product		<input type="checkbox"/> Submitted product differs from tested product(s) as explained in attached letter	
Housing finish color				
Tenon nominal pipe size	inches			
Nominal luminaire weight	lb			
Nominal luminaire EPA	ft <sup>2</sup>			
Nominal luminaire input voltage	V			
Control interface	<input type="checkbox"/> None	<input type="checkbox"/> ANSI C136.10 (3-pin)	<input type="checkbox"/> ANSI C136.41, 5-pin	<input type="checkbox"/> ANSI C136.41, 7-pin
LED driver	<input type="checkbox"/> Not dimmable	<input type="checkbox"/> Dimmable, 0-10V (IEC 60929)	<input type="checkbox"/> Dimmable, DALI (IEC 62386)	
Electrical immunity—ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV / 3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV / 10kA)	
Upon failure of electrical immunity system	<input type="checkbox"/> Possible disconnect		<input type="checkbox"/> No possible disconnect	
ANSI C136.31 vibration test level	<input type="checkbox"/> Level 1 (Normal)		<input type="checkbox"/> Level 2 (bridge/overpass)	
Thermal management	<input type="checkbox"/> Liquids or moving parts		<input type="checkbox"/> No liquids or moving parts	
Luminaire warranty period	Years			
Rated life of LED driver(s)	Hours			

IES LM-80 test duration	Hours	
LED lumen maintenance *	<input type="checkbox"/> Reported (restricted)	<input type="checkbox"/> Calculated (unrestricted)
Make/model of LED light source(s)		
	Nominal value	Tolerance (%)
Luminaire input power—initial	W	W
Luminaire input power—maintained **	W	W
LED drive current—initial	mA	mA
LED drive current—maintained **	mA	mA
In-situ LED T <sub>s</sub>	°C	°C
LED lumen maintenance **	%	%
CCT	K	K
Additional product description		

\* Manufacturer shall indicate which is applicable (check only one box) as per Section 7.4.6. According to IES TM-21, “Reported” values are restricted to 5.5x to 6x (depending on sample size) the duration of IES LM-80 testing, whereas “Calculated” (i.e., projected) values are unrestricted.

\*\* As per Section 7.4.6.

**END OF SECTION**

## APPENDICES

## APPENDIX A

### LIST OF FORMS AND APPLICATIONS

LIST OF FORMS AND APPLICATIONS

Public Works Permit Application (street excavation, greenbelt excavation, paving, curb cut, and other e.g. blasting)

Water Allocation Request Form

Sewer Allocation Request Form

Excess Weight Permit

Escrow Application

*(Forms and applications are available at the City of Winooski Public Works Department and on the City's website)*

